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SMITHSONIAN INSTITUTION

UNITED STATES NATIONAL MUSEUM

Bulletin 108

A REVISION OF THE NEARCTIC TERMITES

BY

NATHAN BANKS

Of the Museum of Comparative Zoology, Cambridge, Massachusetts,

WITH

NOTES ON BIOLOGY AND GEOGRAPHIC DISTRIBUTION

BY

THOMAS E. SNYDER

Of the Branch of Forest Entomology, Bureau of Entomology,
United States Department of Agriculture

Smithsonian Institution,
National Museum.

WASHINGTON
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ADVERTISEMENT.

The scientific publications of the United States National Museum consist of two series, the *Proceedings* and the *Bulletins*.

The *Proceedings*, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original, and usually brief, papers based on the collections of the National Museum, presenting newly acquired facts in zoology, geology, and anthropology, including descriptions of new forms of animals, and revisions of limited groups. One or two volumes are issued annually and distributed to libraries and scientific organizations. A limited number of copies of each paper, in pamphlet form, is distributed to specialists and others interested in the different subjects as soon as printed. The dates of publication are recorded in the tables of contents of the volumes.

The *Bulletins*, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, and catalogues of type-specimens, special collections, etc. The majority of the volumes are octavos, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable.

Since 1902 a series of octavo volumes containing papers relating to the botanical collections of the Museum, and known as the *Contribuions from the National Herbarium*, has been published as bulletins.

The present work forms No. 108 of the *Bulletin* series.

William deC. Ravenel,
Administrative Assistant to the Secretary
In charge of the United States National Museum.

Washington, D. C., February 15, 1920.

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A REVISION OF THE NEARCTIC TERMITES

By Nathan Banks
Museum Comparative Zoology, Cambridge, Massachusetts

WITH

NOTES ON BIOLOGY AND GEOGRAPHIC DISTRIBUTION

By Thomas E. Snyder
Branch of Forest Entomology, Bureau of Entomology, U. S. Department of Agriculture.

PART I.—TAXONOMY.

INTRODUCTION.

During recent years the damage by termites has attracted considerable attention; one of the authors (Thomas E. Snyder) has been particularly interested in this matter, and in the course of his work has gathered a large amount of material. During the season of 1917 Mr. Snyder made a field trip through the Gulf, Southwestern, Rocky Mountain, and Pacific coast regions principally to collect termites and obtain data on their geographical distribution and habits. It was seen that there were various species in the country undescribed or unrecorded, and Mr. Banks has undertaken to distinguish these forms so that the economic work may proceed on a surer basis. The work on taxonomy and the new species are to be credited to Nathan Banks alone.[1] Mr. Snyder, who has published on the ecology of our termites from his wide field observations, has here presented the biological side of the subject and worked up the data on geographical distribution and plotted this on the maps. Mr. Banks has had the advantage of studying the Hagen collection containing various types and has seen collections from the American Museum of Natural History and several experiment stations in the West; but the collection of the Bureau of Entomology, especially that of the Branch of Forest Entomology, is by far the most complete in native species and is the principal basis of the work.

Nearly all of the drawings have been made by Miss Mary Carmody under the guidance of Mr. Snyder; the remainder were made by Mr. Banks. It is desired to here express our appreciation for Miss Carmody's conscientious and careful work.

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[1] Except *Kalotermes approximatus* Snyder.

GENERAL STRUCTURE.

The termites are Neuropteroid insects which live socially in moderate to large colonies. From their gregarious habits and pale color of most forms they are commonly called "white ants." They exist in two or three castes—usually a soldier with modified head, usually a worker caste, and the winged caste which is always present. The winged caste consists of the male and female adult insects. The soldiers occur in all genera except *Anoplotermes*, and originate from young of both sexes; occasionally they show traces of wings. The worker caste occurs in all except the Kalotermitidae; they are small, wingless, and usually blind. There are immature stages for all these castes.

After a flight the winged female breaks off her wings and starts a colony. She becomes enlarged, often greatly, with eggs, and is now known as the queen or "true" queen or queen mother. In some species these "true" queens are very rare, or at least hard to find. Sometimes nymphal forms become fertile without acquiring wings; they vary in number. Females of one of these forms may be present in colonies with "true kings" or males. Thus it is seen that each colony of termites may have from five to seven forms as well as young. This will be discussed in detail under biological notes. However, for systematic purposes, the winged form preëminently represents the species. The soldier is usually more or less characteristic for each species, and in several genera the species can b traced almost as well by soldiers as by adults.

The adult insect has a head nearly or quite as broad as long, flattened, truncate in front, rounded behind. The compound eyes are on the side nearer to the anterior than to the posterior end. In front of the eye is the antennal fossa, from which arises the slender, moniliform antenna, of 12 to 25 or more joints; the first longer than the others. The clypeus is broad; in some forms with a median line. Below the clypeus is a labrum of characteristic shape in each genus. The mandibles are short and the inner edge with several teeth, but the two jaws are not toothed alike. The maxillae end in two corneous curved points; the maxillary palpi are five-jointed, the basal two very short; the lip is small with short, three-jointed labial palpi. The gula is large and of various shapes, according to the genus. In most forms there is an ocellus close to each eye, and in fully one-half the species there is a more or less distinct median aperture on the face, called the "fontanelle" or "fenestra," which is the opening of the frontal gland [1] whose secretion is utilized for defense.

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[1] Thompson (1916) suggests that the frontal gland may have arisen phylogenetically from the ancestral median ocellus, which is now lacking in the termites. The frontal gland is an actual morphological structure, while the term "fontanel" may be used by some authors to mean the area above the gland and by others as the gland opening; that is, "frontal drüse" and "glande frontale," as well as "fontanel."

The prothorax is well separated from the rest of the thorax. The pronotum is of two general shapes, either more or less flat and broadest in front, or with depressed sides and broadest in the middle. The thorax shows a median suture above. The legs vary in size, the tibiae usually longer than the femora, with a few spines, at least at apex, and the tarsus of three or four short basal joints and a much longer apical joint, bearing the simple claws. The tarsi vary but little, but the tibiae and femora may be greatly enlarged or very slender.[1]

The abdomen consists of 10 segments, the first is indistinct or absent below; the apical ventral plate is divided into two, each bearing a two to six jointed cercus (cerci) near its outer edge. In the male, and in some cases in the female also, there is a pair of stylets near the middle of the hind edge of the ninth ventral segment. In the female of some forms the ninth segment is also divided into two parts. In both sexes one or more of the basal ventral plates may show a median division. No sexual organs are visible. (Pl. 1, fig. 2.)

The wings are much longer than the body; several times as long as broad, usually with but few veins, but in some forms there is an irregular network of cross veinlets. The costal vein is very short or absent in our species; the subcosta also short, the radius reaching near the tip of wing. The radial sector arises near base of wing and runs close to and parallel to the radius. In the more primitive forms it bears several superior branches. The median often has one or more branches, and the cubitus has several oblique branches to the hind margin. In one section the median and cubitus and their branches are colorless.

The wings have near the base a more or less distinct transverse impression. After flight the insect breaks off the wings at this point; the part remaining is the wing-scale, and shows the beginning of the venation. The body and sometimes the wings bear hairs; the wing scales are hairy as the body.

In the soldier the head is enlarged and usually elongate; the mandibles usually elongate, simple, toothed, or twisted. The antennae usually have fewer joints than in the adult. In the wood-inhabiting species the legs are usually short; in the species that wander about, the legs are long and slender, and the thorax small. Most of the soldiers have no eyes.

The worker has a shorter and proportionally thicker head than the adult, usually with short mandibles and a very large labrum. The abdomen may be depressed, cylindrical, or narrowed at base. They show no trace of wings and usually are blind.

It is not always possible to correlate the workers or soldiers with the adults of a species. The workers can be placed in the genus, since they agree more or less closely with the adult in their mouth parts. It is probable that there is some difference between workers of allied species,[1] but I have not observed them, and in *Reticulitermes* there is little difference between soldiers of allied species, and, indeed there is no need, as far as the separation of the species is concerned, that either soldier or worker should possess peculiar characters, but the existence of such peculiar structures in either soldier or worker is an argument for the distinction of the species, since these peculiarities are transmitted from generation to generation by the adult insects. However, there is some dimorphism in the soldiers; in certain *Kalotermes* there are soldiers with short and others with long heads, and in certain *Reticulitermes* the head of the soldier varies in length. There is also variation in the size of soldiers, particularly in *Termopsis* and *Kalotermes*, while in *Constrictotermes* the soldier is more constant in size. The nature of the pilosity is constant and of great systematic value. There are no external sexual characters that can be utilized to distinguish species, and such are not necessary, for it is rarely that in any one locality two species of a genus swarm at the same time. Although the color is not striking, it is very constant in each species; likewise the size of the adult is also fairly constant, and both are useful in classification.

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[1] See Snyder, 1919.

HISTORICAL SUMMARY.

The first of our termites to be described was *T. marginipennis* by Latreille in 1832. In 1837 Kollar described *T. flavipes* from a greenhouse in Europe. In 1839 Burmeister described *T. castaneus*, and in 1853 Walker described several and Haldeman two. In 1855 to 1857 Hagen published his famous monograph of the termites. Since then Buckley, Desneux, and the senior author have added a few species. In the Catalogue of our Neuropteroid Insects, 1907, there are 12 species listed from the United States; now we are able to record 36 species and one variety.

Of the 12 termite species listed as known in 1907, one species is not included—"*Eutermes*" *nigriceps* Haldeman described from Mexico has been discarded as lost or indeterminable. One new species was added by the senior author in 1907—*Reticulitermes* (*Termes*) *virginicus*. Two of Hagen's varieties have been reëstablished from obscurity—*Termopsis nevadensis* and *Kalotermes minor*. Three known species have been added to the fauna of the United States, namely, *Kalotermes* (*Termopsis*) *occidentis* Walker, *Prorhinotermes* (*Arrhinotermes*) *simplex* Hagen and *Anoplotermes* (*Termes*) *fumosus* Hagen.

There are now known 19 described species and 17 species and a variety new to science.

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[1] See Snyder, 1919.

Buckley was the first to write about the habits of our species. Later Hagen, Hubbard, Schwarz, Joutel, and Heath studied the biology of various species, and in recent years the junior author has made detailed studies on several of our species.

CLASSIFICATION.

The early divisions of *Termes* were based on adult structures and outline the groups now known as subfamilies. Wasmann in 1897 and later others have placed much importance on the soldier as a basis of division. The soldier is a highly adaptive form and normally in no way connected with reproduction and intercalated in the normal plan of development; it is therefore of little value in determining affinity. To the mature winged insect is intrusted the future of the species. It exists in the winged state but a brief period; it is therefore but little affected by environment, and retains more of those minute ancestral characters which indicate relationship. In view of the diverse, conflicting systems proposed by different writers, too much stress can not be placed upon the adult winged insect as the sole source of classification. The winged form is the parent of the winged form and the parent of the soldier, so that in it is found the origin of all characters of adult as well as those of the soldier; so if the soldier possesses any structures of family or generic value they are transmitted by the winged form, which therefore is the real source of these structures.

The best characters for group classification are found in the wings, head, legs, and cerci. Most of the characters I have used have been used in some sense before, but I have added as a family character to distinguish the Termitinae the cilia on the wing margin. This is correlated with a peculiar color of the wing. By this certain genera are placed differently than by Holmgren, but I feel certain that these hairs are of far greater value than the shape of the pronotum, which is far from being as constant as his tables would indicate. I consider the group to be of two families, and our fauna divisible into four subfamilies. The names of the families, according to all codes, must be based on a contained genus: therefore I can not accept the names given by Holmgren.

The best generic classification, but unfortunately without generic names, was proposed by Haviland; he found good characters for various groups based on both adult and soldier. In recent years Nils Holmgren has published several large works on the termites of the world, more or less of a preliminary sort. Between his families Meso and Metatermitidae there is no real distinguishing structure, and the subfamilies are hardly better defined, the host of genera being based sometimes on adults, sometimes on soldiers. However, he has the immense advantage of studying large collections from all parts of the world.

As in most groups, no one genus is more primitive in all its characters than other genera. As far as venation is concerned *Mastotermes* is the most primitive; among our genera *Termopsis* is the most primitive for venation, cerci, and gula. However, *Kalotermes* is more primitive in possessing ocelli; both lack a true worker caste. As we progress to the more highly specialized forms we find the gula becoming shorter and proportionally broader, the castes more differentiated, the soldiers more specialized (nasuti), the legs often shorter and weaker, the wing-scales smaller, the clypeus longer and more distinctly bilobed, the pronotum smaller and more diamond shaped, the abdomen more cylindrical, and the wings without reticulation. These highly specialized forms have opaque wings with ciliated margins. The opening of the frontal gland—the fontanelle is a character peculiar to certain forms; it therefore furnishes a good basis for primary division. The Rhinotermitinae, by the absence of hair on wings and by the reticulate venation, show affinity with the Kalotermitidae; but by the fontanelle, bilobed clypeus, and reduced costal venation they are allied to the Termitinae.

DISTRIBUTION.

Termites are widely distributed over the world, but as compared to the enormous number of individuals of the different castes in the social communities or nests there are but relatively few species and genera. Termites can be traced back in geological times to the tertiary age. (Handlirsch, 1908.)

While generally associated with the Tropics, termites are by no means restricted to tropical countries. In the United States probably species occur in every State in the Union. They occur as far north as Quesnal Lake in the Caribou Provincial Electoral District in British Columbia (*Termopsis angusticollis* Hagen or *nevadensis* Hagen), on Vancouver Island, British Columbia, and in Washington, Idaho, Montana, and Maine. Hence in America termites occur as far north as latitude 52° 30′. Furthermore, these insects occur at high altitudes in the Rocky Mountains and Pacific Coast Range, elevations of 7,000 to 8,000 feet being reached.

Scudder (1884) in an article entitled The Fossil White Ants of Colorado writes that the composition of the white ant fauna of the ancient Florissant, to which locality the known American fossils are confined, differs considerably from that of the localities known in the European tertiaries. In the first division [1]of the Florissant temites, the genera *Parotermes* and *Hodotermes* occur, which are now represented by living types. In the second division, [2]species in the genus "*Eutermes*" are found. Species of *Nasutitermes* (*Eutermes*) and *Constrictotermes* at present occur only in the southwestern States.

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[1] Genera with a branched scapular vein.

[2] Genera with a simple scapular vein.

At Florissant 26 individuals of termites have been found, representing six species, three in the genus *Parotermes*, one in the genus *Hodotermes*, and two species of "*Eutermes*"; one individual is a "larva."

According to Hagen (1858) no locality in the world has yielded more than nine species of living types of termites; they rarely number more than four. Yet in Washington city, not far south of the Mason-Dixon line, three species of *Reticulitermes* occur. In the Santa Catalina Mountains, Arizona, at least 12 species of termites occur. However, these insects are found more frequently in the Southern States, especially the Gulf and Southwestern States, where all of the 10 genera found in North America are represented.

In America, north of Mexico, 19 known and 17 new termite species and one new variety have been found, representing 2 families, 4 subfamilies, and 10 genera. Two of these genera have not previously been recorded in the United States.

These species are distributed in the genera as follows: *Termopsis*, 3; *Kalotermes*, 9; *Neotermes*, 1; *Cryptotermes*, 3; *Prorhinotermes*, 1; *Reticulitermes*, 9 and 2 varieties; *Amitermes*, 6; *Anoplotermes*, 1; *Constrictotermes*, 2; *Nasutitermes*, 1.

By subfamilies: Termopsinae, 3; Kalotermitinae, 13; Rhinotermitinae, 10 and 2 varieties; Termitinae, 10.

By families: Kalotermitidae, 16; Termitidae, 20 and 2 varieties.

The following table will give an idea of the relative abundance of termites in the various States:

DISTRIBUTION BY STATES.

State.	Species.	Genera.
Texas	14 and one variety.	7
Arizona	12 and one variety.	5
Florida	11	5
California	8	4
Oregon	3	2

In Texas four species and one variety of *Reticulitermes*, occur; Virginia, Maryland, Florida, and the District of Columbia have at least three species of *Reticulitermes*, and many States have two.

Of the 13 species of Kalotermitinae 7 occur in Florida, 4 in Texas, and 3 in Arizona. Of the 9 species of Termitinae, none occur in Florida, 6 occur in Texas, and 4 in Arizona. North of Georgia and east of Nevada (excluding the southwest) there is but one genus—namely, *Reticulitermes*. This genus is evidently of northern origin; several occur in the Palarctic region; a few of ours spread to northern Mexico, but none in South America. Termitinae do not occur in Europe, but are abundant in the Tropics of the Old and New World. The species in the United States have evidently come from the south. Kalotermitinae occur in southern Europe and tropical countries, especially islands. Those in the United States have come from the south, partly through Mexico, partly from the West Indies.

Constrictotermes tenuirostris Desneux was described from Mexico. *Amitermes tubiformans* Buckley has been found in Mexico, and *A. wheeleri* Desneux is very probably a Mexican species. *A. californicus* Banks taken along the International Boundary Line in California and also in the Santa Catalina Mountains, Arizona, probably occurs in northern Mexico. *Anoplotermes fumosus* Hagen described from Mexico is Central American.

Thus it might be said that many of the 36 species occurring in the United States may have been "introduced." As a matter of fact, certain of these species inhabit peculiar faunal regions or life zones that do not recognize arbitrary international boundaries.

SPECIES LIABLE TO BE INTRODUCED.

Of the species most liable to be introduced into the United States may be mentioned the destructive *Leucotermes tenuis* Hagen (subfamily Termitinae) of the Bahamas and South America. Various other species of the West Indies and Mexico are liable to be introduced at any time.

NOMENCLATURE.

Termes was used by Linnaeus in the tenth edition of his Systema Naturae (page 609, 1758) for three insects, one termite, and two psocids. The latter have been removed. The one termite was *Termes fatale* of India; this is then the type of the genus. Several have credited the genus to Hagen, and Holmgren puts Smeathman as authority for the genus, and several have considered *T. bellicosus* as type. *Termes* will therefore replace *Odontotermes*. "*Eutermes*" was founded by Heer in 1849[1] for several fossil termites, all winged. It would seem needless to say that one of his species must be the type, yet other species have always been selected, and several writers have credited the genus to Hagen, or Fritz Müller, at much later dates.

One of Heer's species, *E. debilis*, according to Hagen[2] was not from "Bernstein" but from gum copal, and Heer agrees with him. Hagen examined the type and identified it with a living species from Porto Rico. One of Hagen's specimens is before me. It is a small form, with obsolete fontanelle, and the wing membrane plainly hairy; the mandibles are not elongate. It is a *Microcerotermes*, allied to *M. struncki*. I select *E. debilis* Heer as type of *Eutermes*, and thus *Eutermes* will replace *Microcerotermes*.

Termopsis was also erected by Heer for fossil species. Girard (1879) says the type is *angusticollis*, and Wasmann (1897) says the type is *occidentis* Walker the latter being a *Kalotermes.* I have chosen *T. insignis* Heer, a species which appears to be truly congeneric with our *T. angusticollis.*

---

[1] Insektenf. von Oeningen., vol. 2, p. 23.

[2] Monogr. Linn., Ent., vol. 12, 1858, p. 207.

Kalotermes (or *Calotermes* as it is usually written) was first used by Hagen in a note on the Mosambique Neuroptera in 1853. No species are mentioned. The next year in a note on fossil Neuroptera, he refers to it *T. berendtii* Pictet. This, then, must be the type. Most authors have chosen *K. flavicollis* as type. It is extremely unfortunate that three of the principal genera have thus been based on fossil species, and it will always be more or less uncertain whether these names really apply to any living termites.

In the division of "*Eutermes*" I have also met with difficulties. In 1890 Dudley proposed two generic names for species with nasuti soldiers. He failed to mention any specific name. In 1910 Holmgren made several subgenera in "*Eutermes.*" One of these we have. For one "*Eutermes*" form I have adopted Dudley's first name as a new generic name, although I am aware that certain rules would hold the name with Dudley as author. I can not find that our species fall in the new subdivisions of Holmgren. It is also unfortunate that our common termite, now well known under the generic name of *Leucotermes*, should have to have a new and less euphonius name; but the type species of *Leucotermes* is not congeneric with our common species.

SYSTEMATIC POSITION OF NEARCTIC TERMITES.

In order to show the position of our termites in the general classification of the group I have presented a table of the families and subfamilies of the world. This is much different from that of Holmgren at first view, but it should be remembered that three of his four family names are not based on any included generic name, contrary to all rules. I have, however, altered the content of certain of his groups and more sharply defined them by the use of the cilia on the wing margin—a character, I believe, of almost prime importance; in fact, it might be better to unite the Stolotermitinae with the Termitinae in a family, and raise the Mastotermitinae to a family; then there would be four families as follows:

Mastotermitidae.
Kalotermitidae = Protermitidae of Holmgren.
Rhinotermitidae = Mesotermitidae (partly) of Holmgren.
Termitidae = Metatermitidae of Holmgren.

But such an arrangement neglects the value of the frontal gland or fontanelle, which I consider of greater importance than the retention of primitive characters.

SYNOPSIS OF FAMILIES AND SUBFAMILIES.

1. Clypeus not divided by median line; radial sector with one or more superior branches (rarely none); no fontanelle; gula longer than broad. KALOTERMITIDAE—2.

Clypeus divided by a median line; radial sector without superior branches; fontanelle present or indistinct; gula as broad as long............TERMITIDAE—5.

2. Hind wing with large post-anal field, costal and subcostal veins distinct; ocelli present; wings reticulate............Mastotermitinae.

Hind wing without post-anal field............3.

3. Wing margin ciliate, wings not reticulate; no ocelli............Stolotermitinae.

Wing margin not ciliate; wings more or less reticulate............4.

4. No ocelli; tibia usually with more than three spines............Termopsinae.

Ocelli present; tibia with three apical spines............Kalotermitinae.

5. Wings clear, without hairs, margin not ciliate; posterior venation indistinct, partly reticulate............Rhinotermitinae.

Wings more or less opaque, outer and hind margins ciliate, or at least membrane near margin hairy; posterior venation distinct............Termitinae.

TABLE OF AMERICAN TERMITOIDEA.

KEY TO FAMILIES AND SUBFAMILIES.

Winged.

1. Radial sector with some apical superior branches; clypeus not bilobed; no fontanelle; gula longer than broad; wing margin not ciliated; pulvillus present............KALOTERMITIDAE—2.

Radial sector without superior branches; clypeus bilobed; fontanelle more or less distinct; gula as broad as long; pulvillus absent; cerci two or three jointed ....TERMITIDAE—3.

2. Cerci plainly five or six jointed; no ocelli; wings reticulately veined; legs reach much beyond body............Termopsinae.

Cerci two or three jointed; ocelli present; wings but little if at all reticulate ....Kalotermitinae.

3. Outer and hind margins of wing not ciliated; wings clear without hairs, more or less reticulate; clypeus usually fully three times as broad as long; posterior venation no darker than membrane; legs reach beyond tip of body ....Rhinotermitinae.

Outer and hind margins of wings minutely ciliated; wings opaque, more or less hairy, rarely reticulate; clypeus usually not three times as broad as long; posterior venation darker than the membrane............Termitinae.

Soldiers.

1. Cerci prominent, of three or more joints; tarsi of five joints; tibia with spines before apex; no fontanelle; clypeus not bilobed; mandibles toothed, but unlike ....Termopsinae.

Cerci indistinct, of one or two joints; tibia at most with 2 to 3 apical spines, tarsi of not more than four joints............2.

2. Clypeus not bilobed; tibia with three apical spines; mandibles toothed, either unlike or alike; no fontanelle; head never nasute............Kalotermitinae.

Clypeus bilobed; tibia not spined; mandibles not toothed, or toothed alike; fontanelle more or less distinct............3.

3. Gula region as broad in middle as in front; pronotum more or less bent down on sides, somewhat diamond shaped; head nasute or else mandibles toothed ....Termitinae.

Gula region narrowed in middle; pronotum flat, about as broad in front as in middle; head never nasute; mandibles not toothed............Rhinotermitinae.

DESCRIPTION OF SUBFAMILIES, GENERA, AND SPECIES.

Subfamily TERMOPSINAE.

Genus TERMOPSIS Heer.

Winged.—Head without fontanelle or ocelli; clypeus very short, five or six times as broad as long: gula much longer than broad, labrum large, tip truncate; antennae of over 20 joints; front wing scales much longer than the pronotum, twice as large as the hind pair. Legs reach beyond body. Tibia of legs with several spines before tip. Wings large, densely reticulate, margin not ciliate; the radius runs out beyond middle of wing, without branches: the radial sector has several long superior branches, and one or more less distinct inferior branches; the median vein is far back of radial sector, and from near middle has several branches; the cubitus runs out long before tip; cerci long, five or six jointed.

Soldier.—Head large, labrum broad, truncate on tip: no fontanelle; mandibles long, toothed unlike; antennae over 20 joints; gula plainly narrowed in middle; tibia with spines before tip; cerci prominent, three or more jointed.

KEY TO SPECIES.

Winged.

1. Body with long erect hairs, a few above on head; eyes about one-half their short diameter from lower head margin; anterior corners of pronotum hardly rounded .... *laticeps.*
   Body with only very short fine hairs, practically none on head above; eyes about short diameter from the lower head margin; anterior corners of pronotum rounded .... 2.
2. Body pale yellowish, wings gray .... *angusticollis.*
   Body darker, wings also darker .... *nevadensis.*

Soldiers.

1. Pronotum angulate on anterior lateral corners; femora not much swollen; basal six or eight antennal joints as the others, plainly longer than wide .... *laticeps.*
   Pronotum rounded on anterior corners; femora greatly swollen; basal six or eight joints of antennae hardly longer than wide .... *angusticollis.*

TERMOPSIS ANGUSTICOLLIS Hagen.

Winged.—Castaneous; head rather darker in front, pronotum not as reddish, femora also more yellow. Wings uniform dark gray or pale brown; the costal area more yellow. Head much broader above eyes than below. Eye fully one and one-half times higher than broad, about its short diameter from lower margin; (fig. 1 *b*) antennae as long as head plus pronotum, about 25 to 27 joints, second, third, and fourth joints very short, beyond middle longer, the last joint smaller in diameter than others. Pronotum about twice as broad as long, front margin hardly concave, anterior corners rounded, sides sloping a little behind and rounded into hind border; front wing scale very much longer than the pronotum. Wings twice the length of the entire body, moderately broad; not much over four times as long as broad; the costal area near tip very broad, radial sector six to nine branches above; the first branch often only one-fourth way out. Legs fairly stout, the femora thick, mid and hind tibia with several spines below, fore and mid tibiae with usually two spines on the outer side; the head is polished, practically without hair on front; the thorax and abdomen with minute short, fine, erect hair; margin of pronotum with longer hairs.

Length of wing, 23 to 25 mm.; width of wing, 5.2 to 5.5 mm.

Soldier.—Castaneous; head darker red, more black in front, mandibles black. Head a little broader behind than in front, about one and one-fourth times longer than broad; eyes pale hyaline, a little behind antennal pit; mandible about as long as width of head in front, nearly straight, left with large sharp tooth beyond the outer third, a broad one near basal third, between the two; the edge is finely serrate; right mandible with two teeth toward base fitting each side of the broad subbasal one of the left mandible; antennae not as long as head, of 25 joints or more. Pronotum much narrower than head, more than twice as broad as long; sides only little

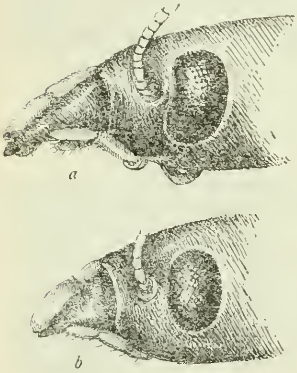

FIG. 1.—SIDE VIEWS OF THE HEADS, SHOWING THE EYES OF THE SEXUAL, WINGED ADULTS, CONTRASTING THE DISTANCE OF THE EYE FROM THE MARGIN OF THE HEAD AND THE RELATIVE LENGTH OF THE EYES. GREATLY ENLARGED. *a*. TERMOPSIS LATICEPS; *b*. TERMOPSIS ANGUSTICOLLIS.

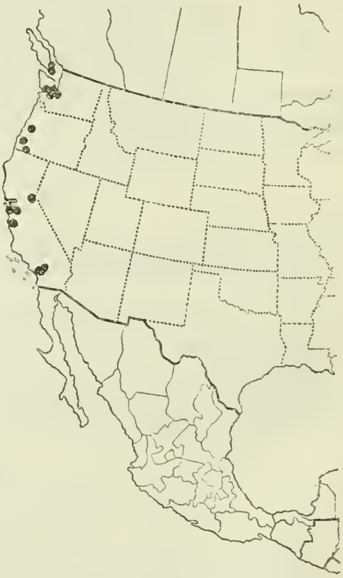

FIG. 2.—DISTRIBUTION OF TERMOPSIS ANGUSTICOLLIS.

narrowed at first, then gradually rounded into hind border. Legs short, femora greatly enlarged; tibia with some spines especially below. Body with scattered, erect hairs; legs with more numerous erect hair.

Length, 15 to 19 mm.

Occurs from southern California (Los Angeles), through Oregon and Washington north to Vancouver Island, British Columbia. (Fig. 2).

TERMOPSIS NEVADENSIS Hagen.

T. nevadensis agrees in general with *angusticollis*, but is smaller and darker; the femora usually infuscated, the abdomen brown or almost black. The wings are rarely 20 mm. long, and about 4 mm. wide; the costal area near tip is hardly as broad proportionally as in the typical form. The pronotum is less broad and the sides more evenly rounded into the hind border; the eye is less than its short

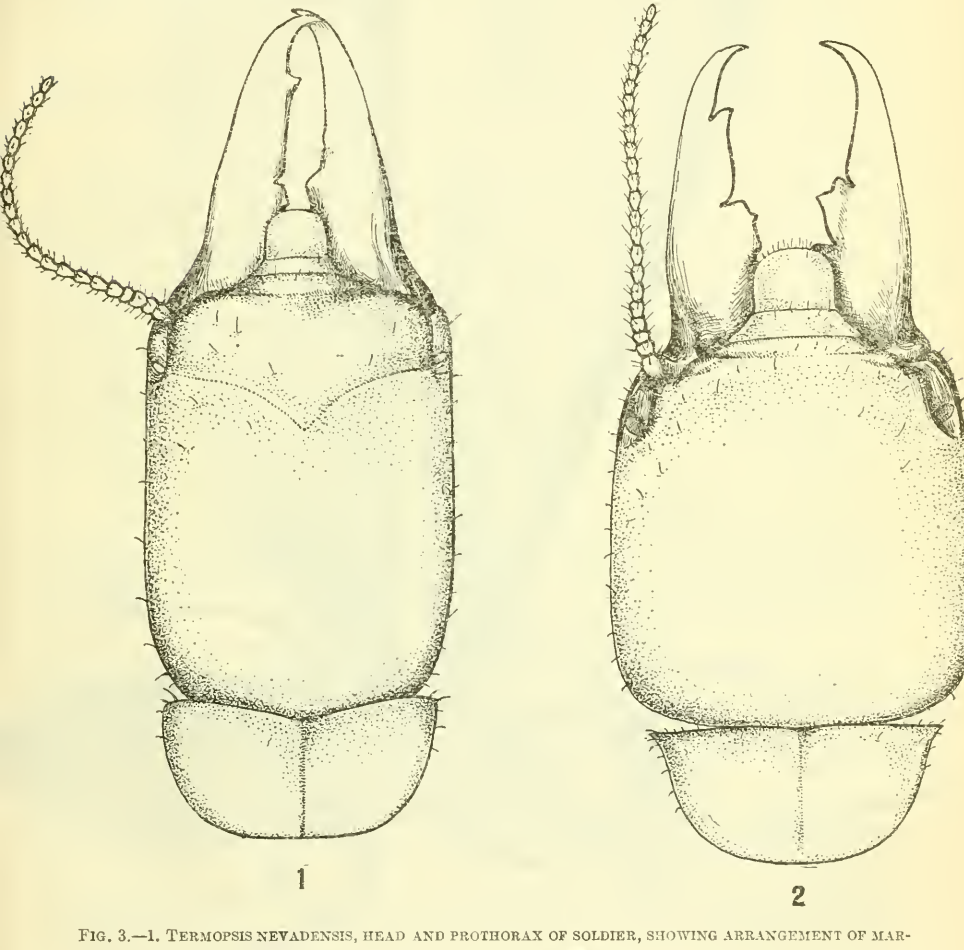

FIG. 3.—1. TERMOPSIS NEVADENSIS, HEAD AND PROTHORAX OF SOLDIER, SHOWING ARRANGEMENT OF MARGINAL TEETH ON MANDIBLES AND ANTENNAE. × 18. 2. TERMOPSIS LATICEPS, HEAD AND PROTHORAX OF SOLDIER, SHOWING ARRANGEMENT OF MARGINAL TEETH ON MANDIBLES AND ANTENNAE. × 16.

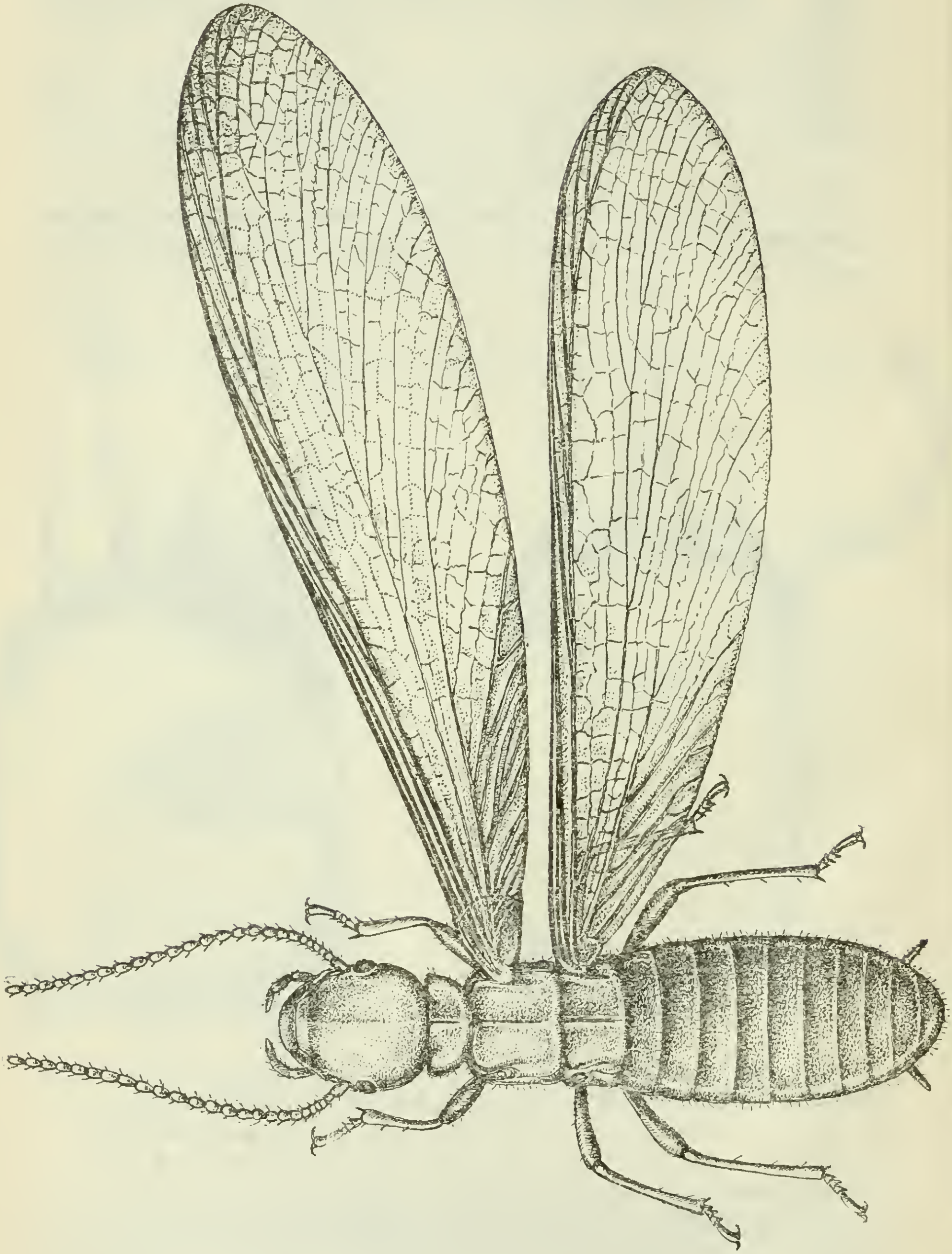

FIG. 4.—TERMOPSIS NEVADENSIS. DORSAL VIEW OF SEXUAL, WINGED ADULT. × 10.

diameter from the lower margin of the head (in *angusticollis* usually fully the short diameter away). The hairs on the legs are longer; for example, on the upper surface of hind tibia there are various hairs whose length is fully one-half the diameter of the tibia, while in *angusticollis* these hairs are less than one-half the diameter of the tibia. (Fig. 4.) Both species have been taken winged at the same place on the same date—(Divide, Oregon, Sept. 12). I can not now distinguish the soldiers; some specimens have the front margin of pronotum emarginate in the middle. (Fig. 3, 1).

Occurs from western Nevada to Montana and through various places in Oregon to British Columbia, and south to Pacific Grove, California (fig. 5).

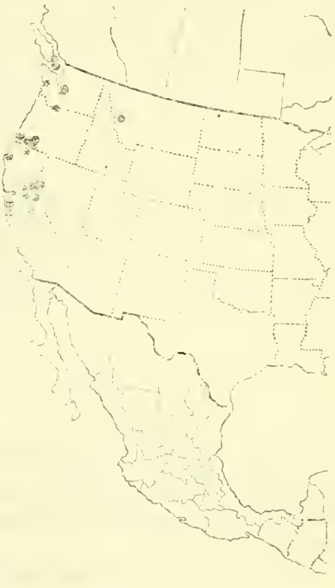

FIG. 5.—DISTRIBUTION OF TERMOPSIS NEVADENSIS.

TERMOPSIS LATICEPS Banks.

Winged.—Castaneous; abdomen and legs more yellowish. Wings pale gray, with costal area yellowish, much paler than in *angusticollis*. Structure similar to *angusticollis;* the eyes are much larger, being hardly one-half their short diameter from lower margin of head (fig. 1*a*); the antennae as long as head and pronotum, of 24 joints. The pronotum has the anterior corners more pointed than in *angusticollis*. Wings have the costal area near tip less broad than in *angusticollis*, but toward base the veins are hardly as crowded together as in that species; the radial sector has five to seven branches above. The head as well as the rest of the body has long erect hairs above; the tibia has spines about as in *angusticollis*.

Length of winged adult 22 to 24 mm.; width nearly 6 mm.

Soldier.—Castaneous; abdomen and legs more yellow, head rather reddish, mandibles mostly black. Head as broad behind as long, broader behind than in front; mandibles toothed similar to *angusticollis;* antennae rather longer than head, 23 joints, the joints, especially toward base much longer than in *angusticollis;* pronotum not twice as broad as long, anterior margin straight, the anterior angles acute, sides sloping and rounded into the hind margin. Femora not nearly as much swollen as in *angusticollis*. Body with only very fine short hair. (Fig. 3, 2.)

Length, 16 to 22 mm.

Occurs in Arizona and New Mexico. Las Cruces, Dona Ana County, New Mexico. In Arizona occurs at Douglas, Palmerlee, Garcia, and in the Huachuca Mountains (all in Cochise County); the Santa Rita Mountains in Santa Cruz and Pima Counties; the Catalina Mountains in Pima County (Sabino Basin and Edgar Canyon), north to the Galiuro Mountains in Graham County and Florence in Pinal County (fig. 6).

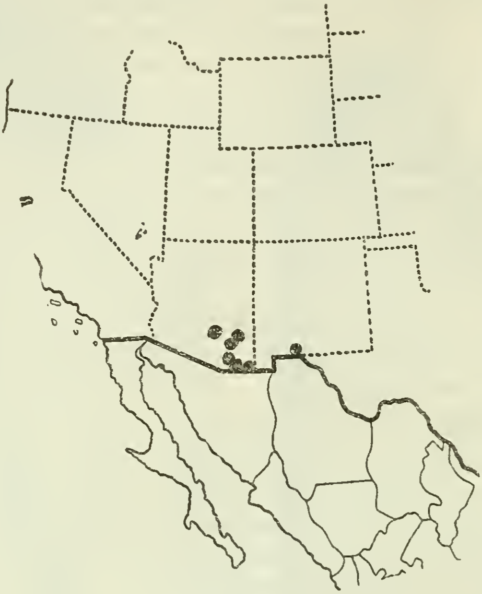

FIG. 6.—DISTRIBUTION OF TERMOPSIS LATICEPS.

Subfamily KALOTERMITINAE.

KEY TO GENERA.

Winged Forms.

1. Fore wing with the median about one-half way between radial sector and the cubitus, weakly chitinized..*Kalotermes.*
Fore wing with median running much nearer to radial sector than to the cubitus, and strongly chitinized..*Neotermes.*
Fore wing with median running up into the radial sector near or beyond middle, weakly chitinized..*Cryptotermes.*

Soldiers.

1. Head enlarged and truncate in front, with a cavity; mandibles toothed alike..*Cryptotermes.*
Not so..2
2. Third joint of antennae more chitinized than others, and elongate or modified in some way; hind femora enlarged..*Kalotermes.*
Third joint of antennae similar to the fourth and others; hind femora slender..*Neotermes.*

Genus KALOTERMES Hagen.

Winged.—Ocelli present; no fontanelle; clypeus broad and short, not bilobed; labrum very broad, truncate or rounded on tip; antennae rarely over 20 joints, gula longer than broad; cerci indistinct; legs very short, tibia with apical spines; forewing scales as long or longer than pronotum, very much longer than the hind pair.

Wings slender; costal venation distinct, other colorless; margin not ciliate, no hairs on surface; radial sector with several superior branches, and often one or more less distinct inferior branches; sometimes faintly reticulate near apex behind radial sector, not elsewhere; median vein runs parallel to the cubitus and ends near tip, usually in one or more forks; cubitus runs out to near tip of wings.

Soldier.—Head more or less elongate; mandibles large, armed with teeth, but unlike; clypeus not bilobed; cerci indistinct; tibia with three apical spines; legs short, all femora greatly enlarged; third joint of antennae often enlarged or modified. Originally spelled with a "K" it was later amended to *Calotermes*.

KEY TO SPECIES.

Soldiers.

1. Third joint of antennae fully as long as next four together; pronotum dentate on anterior lateral margins.......... *hubbardi.*
   Third joint much shorter.......... 2
2. Pronotum very deeply excavate on front margin, much narrowed behind; eyes dark; head about as broad as long (5 mm); third antennal joint about as long as next three together.......... *occidentis.*
   Not so.......... 3
3. Third joint of antennae fully equal the next three together.......... 4
   Third joint much shorter.......... 5
4. Pronotum twice as broad as long, not deeply angularly emarginate in front. .*minor.*
   Pronotum not twice as broad as long, deeply, angularly emarginate in front. *texanus.*
5. Third joint of antennae but little longer than the fourth; pronotum more roundly emarginate in front; eyes black.......... *jouteli.*
   Third joint equal to next two together; pronotum angularly emarginate in front.......... 6
   Third joint of antennae not longer than the next, and unmodified....*simplicicornis.*
6. Pronotum with lateral anterior edges plainly serrate.......... *marginipennis.*
   Pronotum with lateral anterior edges not serrate; northern Florida. .*approximatus.*
   Pronotum not plainly serrate; southern Florida.......... *schwarzi.*

Winged.

1. Abdomen black or blue-black above, wings blackish; eyes fully three diameters from hind margin of head; body with very fine, short hair.......... *minor.*
   Abdomen paler.......... 2
2. Transverse rows of long, erect hairs on dorsum of abdomen, a few long, erect hairs on head or pronotum.......... 3
   No such long hairs; only very short hairs, if any.......... 5
3 Pronotum plainly not twice as broad as long; eyes fully twice their diameter from hind margin of head; Eastern species.......... 4
   Pronotum twice as broad as long; eyes about one and a half diameter from hind margin of head; larger Western species.......... *occidentis.*
4. Ocelli elongate, oblique; 15 to 16 mm. to tip of wings; from southern Florida. *schwarzi.*
   Ocelli more round, less oblique; 11 to 12 mm. to tip of wings; from Georgia, North Florida to Texas.......... *marginipennis.*
5. Distinct dark marks inward from antennae; abdomen distinctly minutely pilose above; from Florida.......... *jouteli.*
   No such markings; abdomen almost hairless; from Arizona.......... *hubbardi.*

KALOTERMES OCCIDENTIS Walker.

Soldier.—Pale castaneous; abdomen paler, especially below; mandibles black; legs brownish yellow. Head very large and broad, broader behind than in front, about as broad as long (nearly 5 mm.), depressed in the anterior middle area; eyes distinct, black, nearly twice as high as broad; ridge over base of the antennae much elevated and roughened; labrum nearly truncate on tip; mandibles stout, short, about half the length of head, toothed about as usual, the two teeth toward tip of left mandible subequal; gula not half as wide in middle as in front. Antennae very short, third joint nearly equal to next three joints. Pronotum twice as broad as long in the middle, broadest across front, very deeply, roundly emarginate in front, much narrowed behind, and the posterior sides rounded into the hind margin; the meso and metanotum have distinct wing pads; legs very short, femora much swollen. (Fig. 8.)

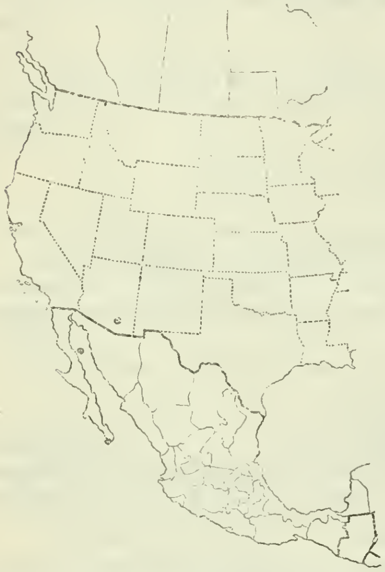

Fig. 7.—Distribution of Kalotermes occidentis.

Length, 14 to 15 mm. (Description drawn from one of Walker's types.)

Soldiers from west coast of Mexico, Lower California, Cape San Lucas, and Angel Guardia Island, Gulf of California, Townsend Expedition.

This is the type of Holmgren's genus *Pterotermes;* it is, however, a true *Kalotermes* in all essential characters; the presence of wing pads on soldiers of *Kalotermes* is not unusual.

Winged.—Light castaneous above, pale beneath; eyes large, much less than diameter from lower margin of head and only about one and a half diameter from hind margin; ocelli moderately large, close to eyes. Antennae nearly as long as head, of 20 to 21 joints; first three joints darker than others, third slightly longer than the second. Pronotum about twice as broad as long, broadest in middle, slightly, evenly concave in front, posterior sides rounded into the hind margin. Wing scale very large, plainly longer than pronotum. Abdomen very large and broad. Head, thorax, and wing scales with moderately long, erect hair; abdomen with fine hair, and some long, erect ones in transverse rows. Wings pale grayish; costal veins yellowish, about twice as long as body; four branches from radial sector to

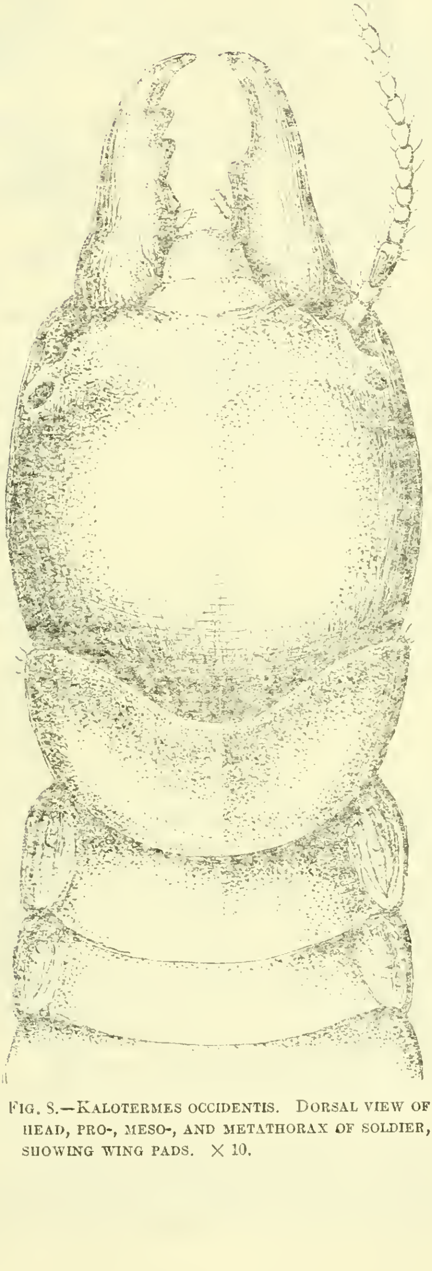

FIG. 8.—KALOTERMES OCCIDENTIS. DORSAL VIEW OF HEAD, PRO-, MESO-, AND METATHORAX OF SOLDIER, SHOWING WING PADS. × 10.

costa; the first before middle of wing, median vein running closer to cubitus than to radial sector, about nine branches to cubitus; those beyond basal ones forked.

Length to tip of wing, 18 to 20 mm.

From Arizona; Sabino Canyon, Santa Catalina Mountains, January 7 (adults in colony with wing stubs) (Hofer coll.), and Coyote Mountains, August 4 to 7, and Baboquivari Mountains, August 7 to 9 (Lutz and Rehn), (flying). (Fig. 7.)

I am not certain that these are the adults of Walker's *K. occidentis*, which was based on a soldier; however they will agree in size, and we know of no other soldier for them; if not Walker's species they represent a new species.

KALOTERMES MARGINIPENNIS Latreille.

Winged.—Yellowish to castaneous; head pale behind; thorax pale in middle; venter and legs pale; the pronotum usually shows a large dark spot at posterior corners. Head much broader above than below. Eyes a little higher than long, less than diameter from lower margin, fully two diameters from the hind margin; ocelli touching eyes and inward from them; antennae 16-jointed, as long as width of head; third joint plainly a little longer than the second, and a little darker in color. Pronotum about twice as broad as long, broadest in middle, sides rounded, anterior margin almost straight across, hind margin faintly emarginate in middle. Wings twice as long as abdomen, pale, but the marginal veins very distinctly brown; the radial sector usually with six branches to costa; median vein about halfway from radial sector to cubitus. (Pl. 2, fig. 1.) Head and pronotum with long erect hairs, and similar hairs in rows across dorsum of the abdomen.

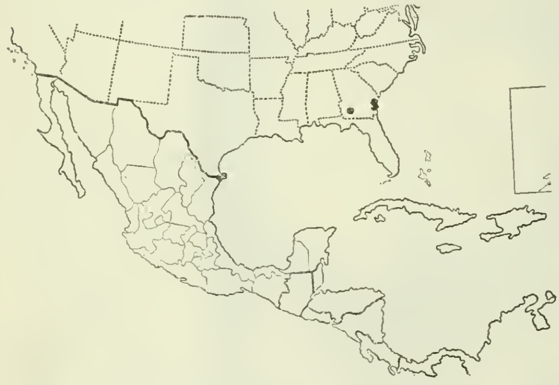

FIG. 9.—DISTRIBUTION OF KALOTERMES MARGINIPENNIS.

Length to tip of wings, 11 to 12 mm.

Soldier.—Head yellowish, darker in front, almost brown; mandibles black, antennae pale, third joint brown; pronotum pale yellowish, anterior edge darker; rest of body and legs very pale; tarsi yellow. Head one and two-thirds to fully twice as long as broad; sides parallel, or even faintly concave in long headed forms; ocelli hyaline

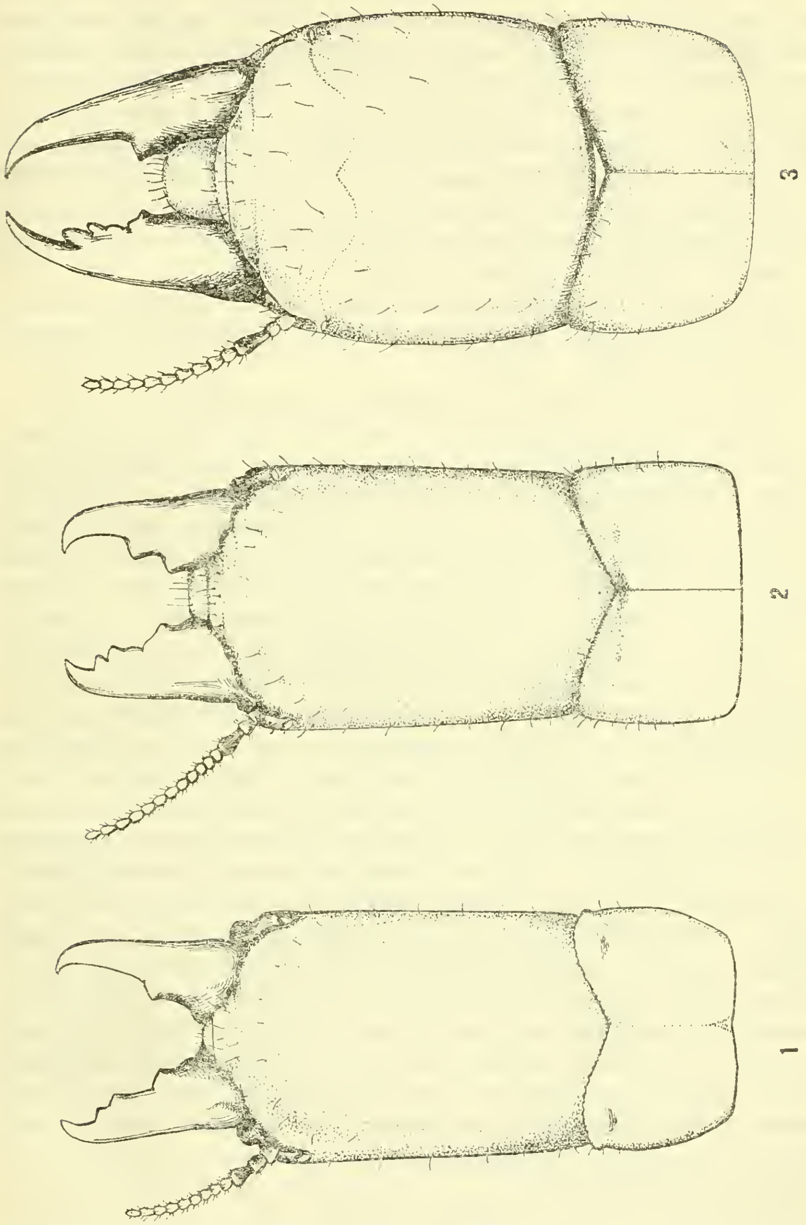

FIG. 10.—1. KALOTERMES MARGINIPENNIS. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER, SHOWING ARRANGEMENT OF MARGINAL TEETH ON MANDIBLES AND ANTENNAE. × 30. 2. KALOTERMES SCHWARZI. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER. × 24. 3. KALOTERMES SCHWARZI. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER, SHORT-HEADED FORM. × 40.

white; antennae reach tips of jaws, 12-jointed; third joint equal next two together; mandibles nearly as long as width of head; right one with two subequal teeth toward base, left one with two subequal at apical third and a long tooth toward base; labrum hardly rounded on tip; gula slender, in middle not half as wide as in front. Pronotum plainly less than twice as broad as long, deeply roundedly emarginate in middle, the lateral anterior part rounded and very plainly finely dentate; posterior sides broadly rounded into the hind border, which is scarcely emarginate in the middle. Legs short, femora much thickened; body and legs with short fine white hair. Length, 7 to 8 mm. (Fig. 10, 1.)

Occurs in Mexico, southwestern Texas, east to southern Georgia, and probably northern Florida, occurring as far north as Savannah, Georgia, and vicinity. (Fig. 9.)

KALOTERMES APPROXIMATUS, new species.

Soldier.—Head yellowish, darker in front to almost brown, mandibles black, reddish brown at base; antennae and pronotum pale yellowish; third joint of antennae brown; legs paler, tarsi yellow; abdomen gray with tinge of yellow. Head one and one-half times as long as broad, sides parallel to slightly concave. Hairs on sides of head and prothorax. Eye round to oval, hyaline white; ocellus visible above eye spot. Antennae reach tip of mandibles,[1] 13-jointed, the third joint is modified; that is, is slightly narrowed (distinctly at base) chitinized and pigmented brown. The *third joint of the antenna is not quite as long as the fourth and fifth together.* Mandibles nearly as long as width of head; right mandible with two subequal marginal teeth near the base, left mandible with three marginal teeth on lower two-thirds, the median tooth being broader. Labrum hardly rounded at tip; gula slender, in middle not half as wide as in front. Pronotum wider than head; less than twice as broad as long, roundedly emarginate in middle, *the lateral anterior portion is not dentate as in marginipennis.* Posterior sides of pronotum broadly rounded into hind border which is scarcely emarginate in the middle. Legs short, femora much thickened; body and legs with short fine white hairs. In general near *Kalotermes marginipennis* Latreille. Length 7.5 mm.

Occurs in northern Florida; collected by T. E. Snyder on March 5, 1919, at Ortega, near Jacksonville, Florida, in chambers in dead stumps of sweet gum trees in woodland; two colonies of nymphs and soldiers. Hopk. U. S. numbers 14108 and 14110.

Winged adult unknown.

Type, soldier.—Cat. No. 22359, U.S.N.M.

KALOTERMES SCHWARZI, new species.

Winged.—Pale castaneous; head paler in front; pronotum pale in front, dark or blackened on the posterior corners; thorax pale in middle; venter and femora pale; tibiae and tarsi more yellowish;

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[1] When mandibles are crossed.

mandibles black on tips. Eyes nearly round, almost diameter from lower margin, hardly twice diameter from the hind margin; ocelli elongate, placed obliquely inward from eyes. Antennae longer than width of head, of about 20 joints; the third darker but no longer than the second. Pronotum broader than head, plainly less than twice as broad as long, broadest in the middle, not rounded much on the posterior sides; anterior margin angularly emarginate, but not deeply. Wings pale, costal veins dark, radial sector with four to six branches to costa; the first few are very long, median vein runs nearer to radial sector than to cubitus. Wing scale a little longer than the pronotum. (Pl. 2, fig. 2.) Head, pronotum, and abdomen with long erect hairs on the abdomen in rows near hind margin of each segment.

Length to tip of wing. 15 to 16 mm.; body, 8 to 9 mm. (Fig. 12.)

Soldier.—Head castaneous, darker in front; mandibles black; legs pale, anterior tibiae usually darker; thorax castaneous above; abdomen paler. Head, from barely longer than broad to fully one and a half times as long as broad; in the long-headed forms the sides are parallel; in the short-headed forms the sides are more convex; labrum truncate; eyes distinct, behind the antennae; antennae fully as long as the mandibles, about 16-jointed, the third joint fully as long as the fourth and fifth together, strongly chitinized, and narrowed at base; the mandibles not as long as width of head; teeth as in figure; in some, the points of the mandibles are more slender than in others; the last joint of the maxillary palpi much longer than the preceding, the gula is about half as wide in middle as in front; the pronotum fits closely over the base of the head; it is about twice as broad as long; the anterior margin is strongly, angularly indented in the middle, and the anterior sides convexly oblique to the indentation; the outer sides nearly parallel, the hind border slightly concave. Femora greatly swollen; the hind tibia with three stout spines. Body and legs with numerous, short, simple, erect hairs.

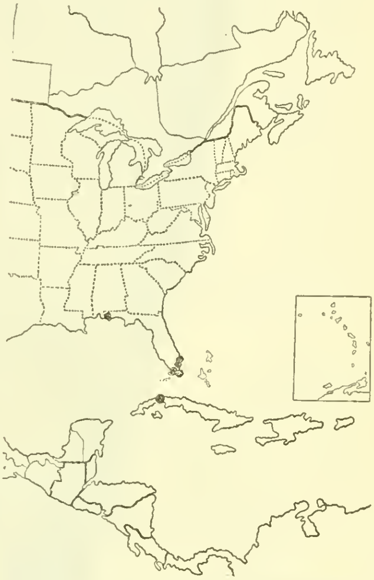
FIG. 11.—DISTRIBUTION OF KALOTERMES SCHWARZI.

Length, 7 to 10 mm. (Figs. 10, 2, and 3.)

Occurs in Cuba and southern Florida both on the offshore keys or reefs (Adam Key) and on the keys which are part of the mainland in the Lower Everglades (Paradise Key). Cocoanut Grove, Miami,

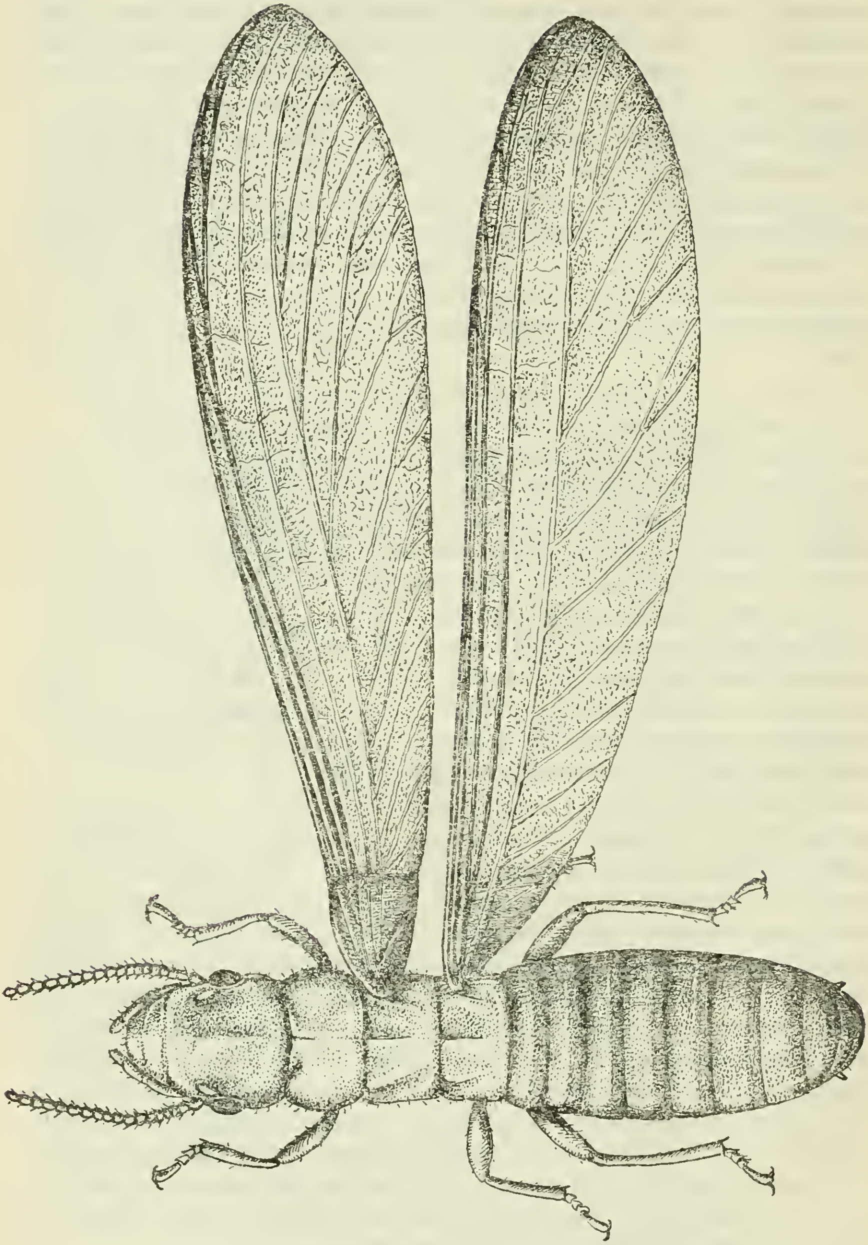

FIG. 12.—KALOTERMES SCHWARZI. DORSAL VIEW OF SEXUAL, WINGED ADULT. × 12.

Miami Beach, Dade County, and Pensacola, Escambia County, represent the known distribution, Pensacola being its northern limit so far as this species is known at present. (Fig. 11.)

Type, winged adult and soldier.—Cat. No. 21856, U.S.N.M.

KALOTERMES JOUTELI, new species.[1]

Winged.—Yellowish, brighter on head, a more or less black mark each side on front edge of the head inward from antennae. Femora pale; tibiae and tarsi more yellowish; venter pale, mandibles mostly black. Head but little broader above than below; above each antenna at the dark spot is a distinct elevation leaving a broad depression between them. Eyes large, nearly circular, less than diameter from lower margin, a little less than twice diameter from the hind margin; ocelli large, nearly round, touching eyes. Antennae longer than width of head; third joint no longer than second and hardly darkened. Pronotum plainly broader than head, about twice as broad as long; posterior sides rounded into the hind margin, anterior margin broadly evenly concave. Wings broken off; wing scale but little longer than the pronotum. Head, pronotum, and dorsum of abdomen with only fine, very short hair; no long erect hairs.

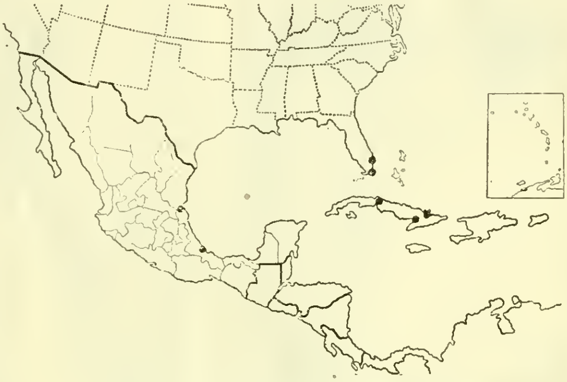

FIG. 13.—DISTRIBUTION OF KALOTERMES JOUTELI.

Length of body, 10 mm.

Soldier.—Head castaneous; mandibles black; thorax, abdomen, and legs rather pale. Head about one and one-fourth to one and one-half times as long as broad; sides slightly convex, broadest in the middle; labrum convex on front edge; mandibles about as long as width of head, toothed as in figure; point rather longer than in *K. marginipennis;* antennae with the third joint not as long as in *K. marginipennis*, but little longer than the next joint; eyes very distinct, black, much more than diameter from antennal pit. Gula in middle about two-thirds as wide as in front. Pronotum fully twice as broad as long; front margin less angularly and more roundly emarginate than in *K. marginipennis.* Femora about as large as in *K. marginipennis.*

Length, from 9 to 13 mm. (Fig. 14, 1.)

Occurs in southern Florida on the offshore reefs (Adam Key). Also in Cayamas, and Woodfred Inn, Pinares, Cuba, and Vera Cruz and Tampico, Mexico. (Fig 13.)

Type, soldier.—Cat. No. 21857, U.S.N.M.

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[1] Described by T. E. Snyder.

KALOTERMES MINOR Hagen.

Winged.—Rather reddish brown; a faint pale V-mark on front of head; abdomen mostly blackish or blue black, paler beneath; legs brownish. antennae pale; third joint dark; tips of mandibles black. Eyes small, circular, fully diameter from lower margin of head, and fully three times diameter from hind edge of head; ocelli a little separated from eyes, oblique, and slightly elongate. Antennae as long as width of head, of 15 joints, the third darker and plainly longer than the second or fourth. Pronotum plainly less than twice as broad as long, broadest in middle; posterior sides rounded into the hind margin, anterior

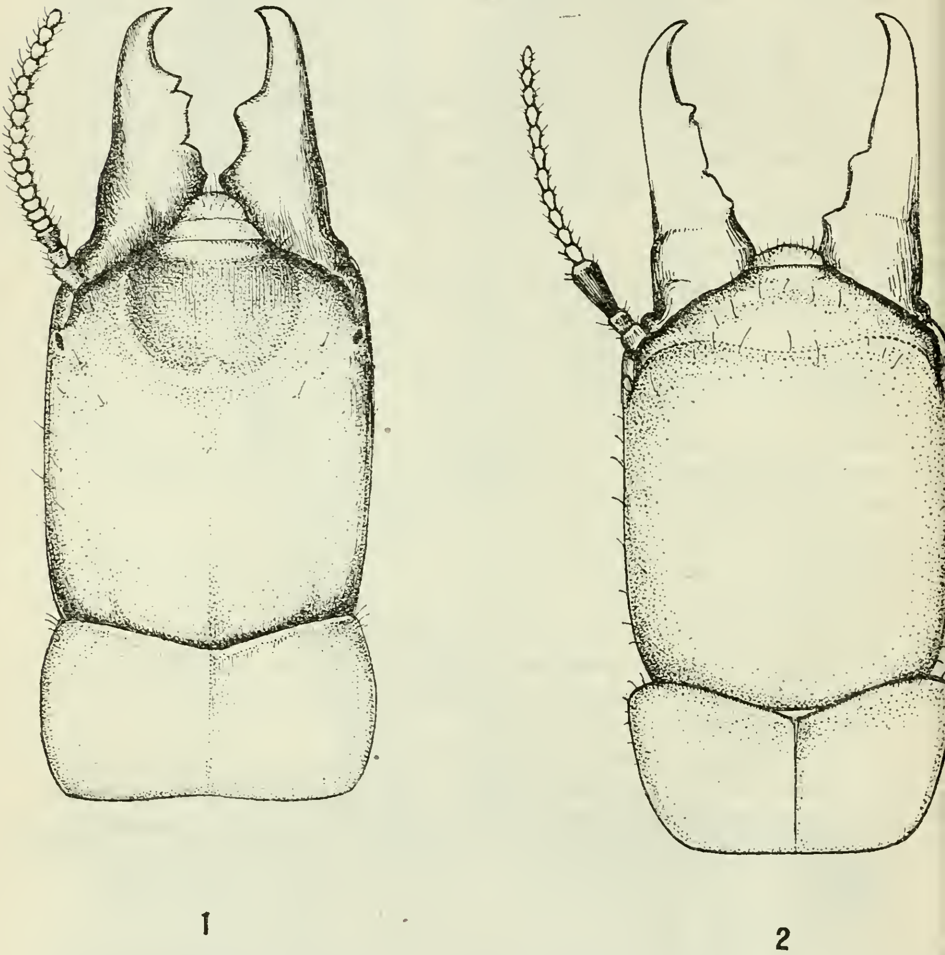


Fig. 14.—1. Kalotermes jouteli. Dorsal view of head and prothorax of soldier, showing arrangement of marginal teeth on mandibles and antennae. × 20. 2. Kalotermes minor. Dorsal view of head and prothorax of soldier. × 30.

margin evenly concave; a black mark usually shows on each side of the front margin. Wings blackish, costal veins black; radial sector with three or four branches to costa, all very long; the median vein runs about halfway from radial sector to cubitus. Wing scale a little longer than the pronotum. (Pl. 2, fig. 3.) Head and pronotum with short but erect hair, abdomen with short hair toward tip; few hairs near base; no long erect hairs in rows.

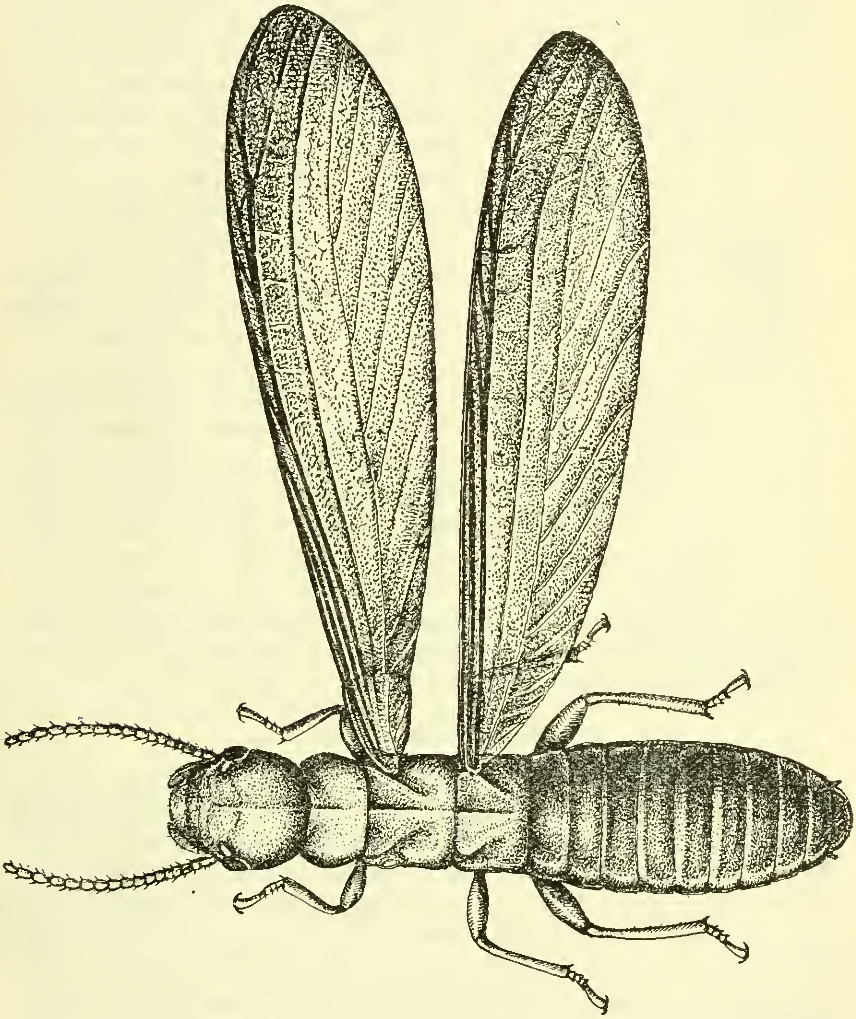


FIG. 15.—KALOTERMES MINOR. DORSAL VIEW OF SEXUAL, WINGED ADULT. × 15.

Length to tip of wing, 11 to 12 mm. (Fig. 15.)

Soldier.—Dark reddish brown, almost black on the anterior part of the head; mandibles black; thorax and part of abdomen castaneous;

rest of abdomen and legs paler. Head about one and one-half times as long as broad, sides nearly parallel; eyes indistinct, about diameter from antennal pit; antennae short, third joint elongated, and at tip swollen, about as long as the next three joints together (but not as long as in *K. hubbardi*). Labrum slightly rounded in front; mandibles about as long as width of head, teeth not very prominent, as in figure; gula very slender, about one-third as wide in middle as in front; pronotum plainly more than twice as broad as long; angularly indented in the middle of front, but the lateral anterior sides are not plainly dentate; posterior margin faintly sinuate. Femora thickened as usual; the tibia rather darker on base than elsewhere.

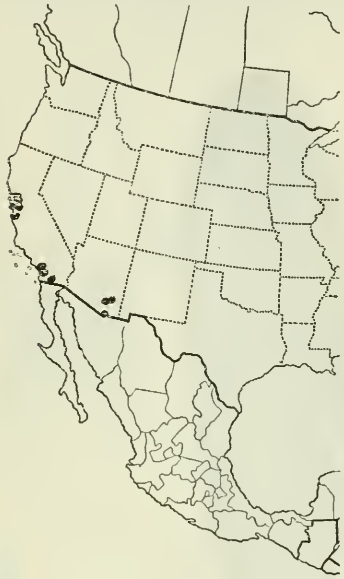


FIG. 16.—DISTRIBUTION OF KALOTERMES MINOR.

Length, 8 to 10 mm. (Fig. 14, 2.)

Occurs in Arizona and California. In Arizona, Nogales (Calabasis Canyon), Santa Cruz County, in the Santa Catalina Mountains (Bear, Edgar, and Sabino Canyons), and Redington, Arizona, all in Pima County. In California Palm Springs (Riverside County), Los Angeles (Los Angeles County), Monterey, and Cypress Point (Monterey County), Los Gatos, San Jose, and Palo Alto (San Jose County) and Niles (Alameda County). (Fig. 16.)

KALOTERMES HUBBARDI, new species.

Winged.—Pale brownish yellow; venter and legs paler; tips of mandibles black, a slightly darker patch at hind corner of pronotum. Head not broader above than below; eyes large, nearly circular, less than long diameter from the lower margin, and not much more than twice their diameter from the hind margin; ocelli nearly round, slightly separated from the eyes. Antennae about as long as width of head, third joint not longer than the second or fourth, and scarcely darker, of 16 joints. Pronotum about twice as broad as long, anterior margin slightly concave; posterior sides slightly rounded into the hind border. Wing scale a little longer than the pronotum. Wings pale, costal veins yellowish, in length about one and a half times the abdomen in female; radial sector six or seven branched, last two or three short; medianvein runs about halfway between radial sector and cubitus. (Pl. 2, fig. 4.) Body with only very fine, minute hair, abdomen above practically without hairs.

Length to tip of wings, 13 mm.

Soldier.—Head castaneous, darker on the frontal slope, which is more sharply delimited than usual; labrum nearly truncate, lateral sides margined; head about one-fourth longer than broad, about as broad behind as in front, the sides slightly convex, eyes rather large, but indistinct, less than their diameter from the antennal pit; the front of head is depressed and this area angularly limited behind by a ridge; mandibles longer than width of head, slender, toothed as in the figure; antennae 11-jointed, the third joint greatly elongated, clavate, dark colored, fully as long as the next four joints together; last joint of the maxillary palpi much longer than the preceding, but not very slender, rather swollen toward the ip, gula hardly one-third as broad in middle as in front; pronotum is about twice as broad as long, deeply, roundedly emarginate in front; the anterior sides toward the corner and over the corner are plainly, irregularly dentate; the outer sides nearly parallel, the hind border convex; legs short; femora thickened, but hardly as much so as in *K. marginipennis;* the tibia with three apical spines.

Length, 6 to 8 mm. (Fig. 18.)

Occurs in Lower California (Cape San Lucas), Arizona, and California. In California, San Diego, and San Jose. In Arizona, at Nogales, along the Santa Cruz River (Santa Cruz County); at Palmerlee and in the Dragoon Mountains, Texas Pass (Cochise County); in the Santa Catalina Mountains (Sabino Canyon, Brush Corral Station), Tucson, and Redington, in Pima County, in the "Graham Mountains," Ash Creek (Graham County?). (Fig. 17.)

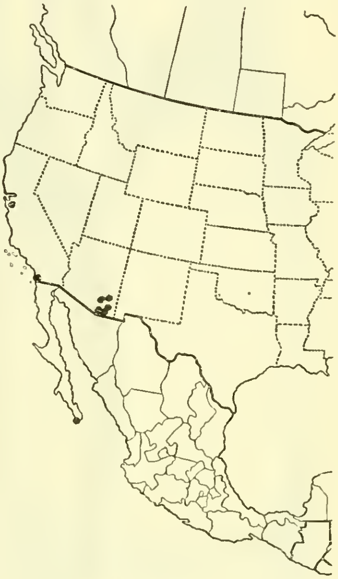


Fig. 17.—Distribution of Kalotermes hubbardi.

Type, winged adult.—Cat. No. 21855, U.S.N.M.

KALOTERMES TEXANUS, new species.

Soldier.—Head yellowish, darker; almost red-brown in front, mandibles black; antennae pale, third joint dark brown, thorax yellowish legs paler; abdomen pale yellowish. Head about one and a half times as long as broad, as broad in front as behind, sides not rounded, antennae short, 12-jointed, reaching hardly beyond tip of mandibles, third joint enlarged, equal to next three together. Mandibles stout,

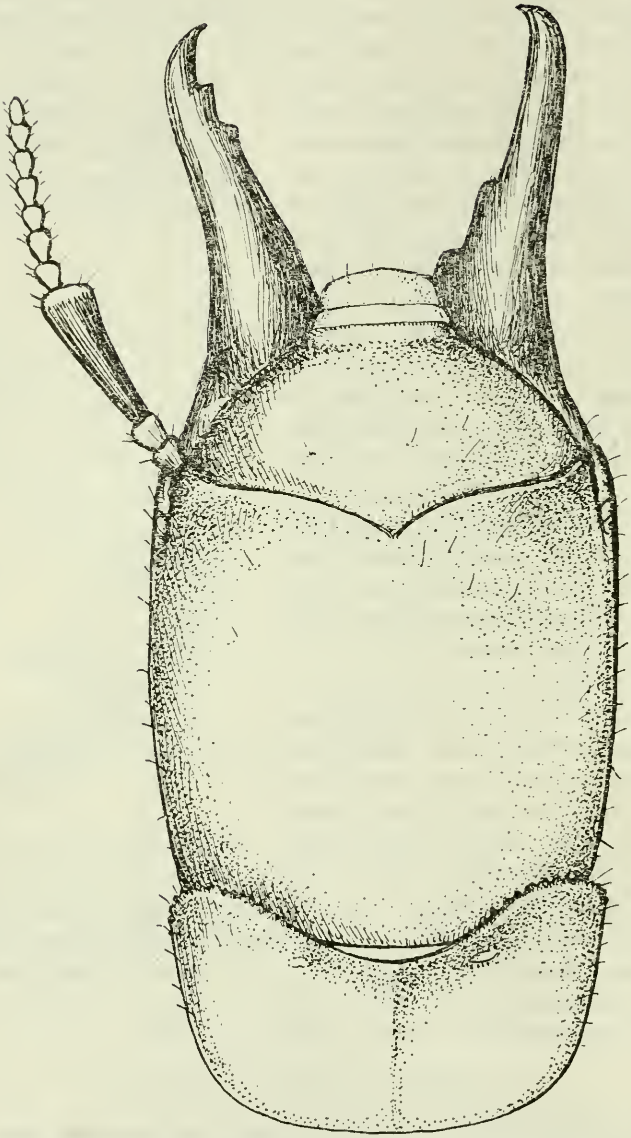


FIG. 18.—KALOTERMES HUBBARDI. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER, SHOWING ARRANGEMENT OF MARGINAL TEETH ON MANDIBLES AND ANTENNAE. (NOTE GREATLY ENLARGED THIRD JOINT OF ANTENNAE.) × 35.

scarcely as long as width of head, teeth not very large, two subequal ones on the right mandible toward base, left mandible with four teeth, one toward outer fourth, a minute one at its base, and two small ones near basal third. Gula slender, its middle not one-half as wide as apical part. Pronotum plainly less than twice as broad as long, little narrowed behind, anterior margin deeply angularly emarginate, the lateral portion rounded and minutely dentate, posterior margin slightly evenly concave. Legs short, femora much swollen, body and legs with scattered very short, fine, white hair.

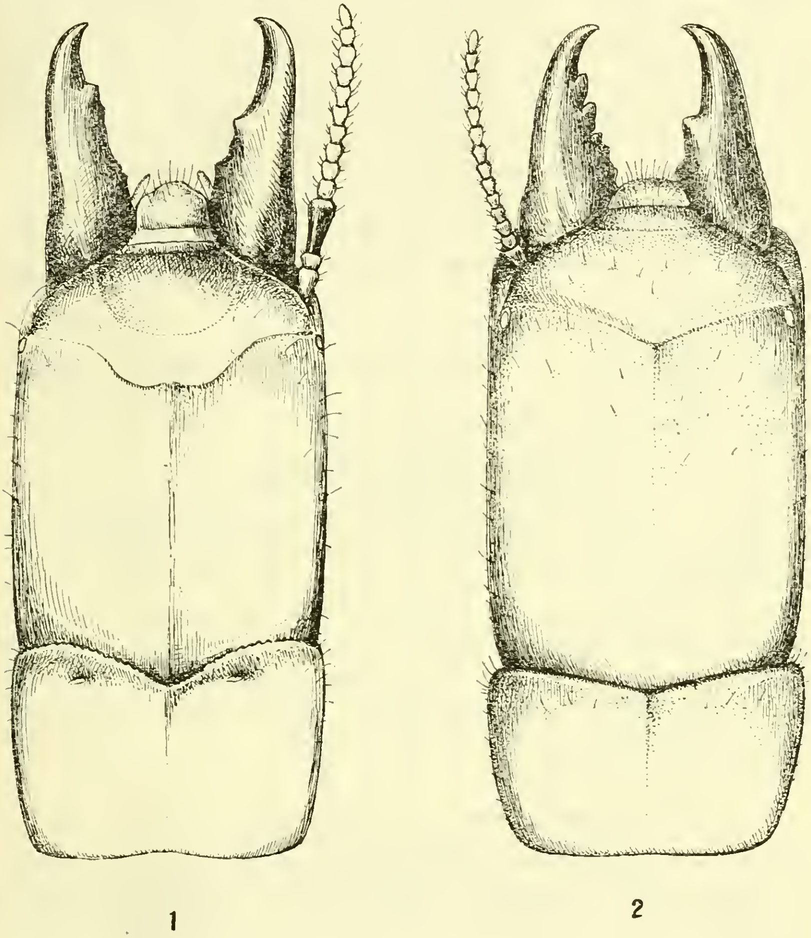


Fig. 19.—1. Kalotermes texanus. Dorsal view of head and prothorax of soldier, showing arrangement of marginal teeth on mandibles and antennae. × 40. 2. Kalotermes simplicicornis. Dorsal view of head and prothorax of soldier. × 40. (Note simple third joint of antennae.)

Length, 8.5 mm. (Fig. 19, 1.)

One soldier from Chalk Bluff, Texas, May 5 (Snyder).

Winged form unknown.

Type, soldier.—Cat. No. 21859, U.S.N.M.

KALOTERMES SIMPLICICORNIS, new species.

Soldier.—Head yellowish, darker in front to almost brown; mandibles black, antennae and pronotum pale yellowish; legs still paler; abdomen gray, mottled with white. Head fully one and one-half times as long as broad, about as broad in front as behind; sides not rounded, parallel, ocelli faint, antennae not as long as width of head, first joint rather short, second two-thirds as long as first; third scarcely longer than second or fourth, and hardly more chitinized, 14 joints in antennae; mandibles heavy and short, not two-thirds as long as width of head, right one with two large subequal, sub-basal teeth, left one with four teeth, two beyond middle are rather large, two minute ones nearer base; labrum rounded at tip; gula in middle about one-third of widest anterior part; pronotum not quite twice as broad as long, but little narrowed behind, anterior margin slightly, angularly emarginate, posterior corners rounded. Legs short, all femora enlarged, but hardly as much so as in some other species. Body and legs with short fine white hairs.

Length, 8 to 9 mm. (Fig. 19, 2.)

From Laguna on the Neuces River, Texas, May 4 (Snyder). Winged form unknown.

Type, soldier.—Cat. No. 21858, U.S.N.M.

Genus NEOTERMES Holmgren.

Winged.—Similar to *Kalotermes*, but the wing has the median vein as strongly chitinized as the radius and radial sector and runs close to the radial sector.

Soldier.—Also similar to *Kalotermes*, but the femora are much more slender, not at all enlarged; the third antennal joint is small like the second or fourth; the mandibles toothed, unlike, but the teeth rather smaller than in *Kalotermes;* three spines at tip of each tibia; gula much narrowed in middle.

We have but one species.

NEOTERMES CASTANEUS Burmeister.

Winged.—Pale castaneous; antennae, legs, and venter pale; wings pale, costal veins castaneous. Head short, not broader above than below; eyes round, large, less than diameter from the lower margin of head, and scarcely two diameters from the hind margin; ocelli obliquely inward from eyes; labrum nearly truncate on tip; antennae much longer than width of head, 16-jointed, third joint not modified; pronotum much broader than head, about two and one-half times as broad as long, sides evenly rounded, anterior margin slightly concave, and posterior margin slightly convex; wing scale but little longer than the pronotum. Wings but little longer than the entire body, radial sector usually with four or five long branches to the costa.

(Pl. 3, fig. 1.) Head and pronotum with many long erect hairs; abdomen with long sloping hairs in rows near hind margin of each segment.

Length to tip of wings, 15 mm.

Soldier.—Head light castaneous, darker in front, mandibles black, paler on base, thorax and basal part of abdomen above slightly castaneous, rest of abdomen paler, but often discolored; legs pale. Head about one and one-third times as long as broad, broadest in front just back of the antennae; labrum broad with convex front margin; antennae not as long as width of head, 16 to 19-jointed, the third joint no longer and barely more chitinized than others near by; last joint of the maxillary palpi slightly longer than the preceding. Mandibles short and stout, the point often very blunt, not nearly as long as width of the head; teeth as figured; eyes usually showing just back of the antennae; gula hardly half as wide in middle as in front. Pronotum not as broad as the head at the widest part, fully two and one-half times as broad as long, evenly concave in front, outer sides rather narrowed behind, hind margin not emarginate. Femora moderately slender, tibia with three heavy, reddish spines at tip; body and legs with scattered, short, simple erect hairs.

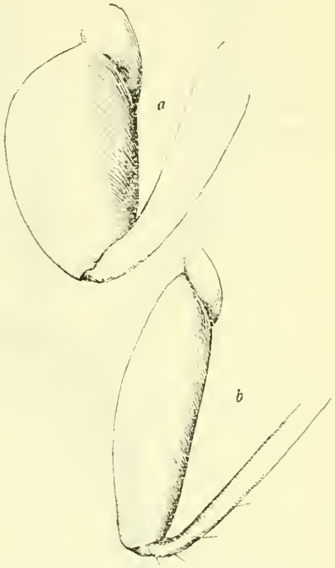


Fig. 20.—Hind femora of a soldier of (*a*) Kalotermes schwarzi contrasted with that of a soldier of (*b*) Neotermes castaneus. Greatly enlarged.

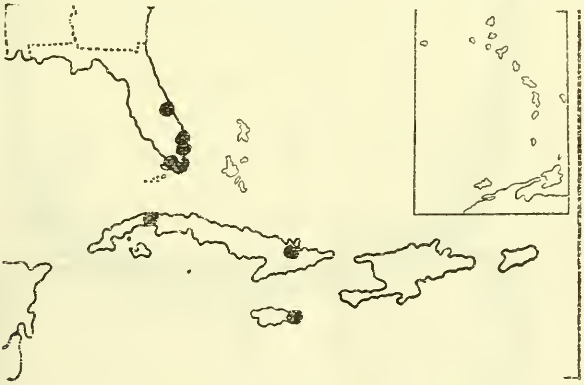


Fig. 21.—Distribution of Neotermes castaneus.

Length, 10 to 12 mm. (Figs. 20*b* and 22.)

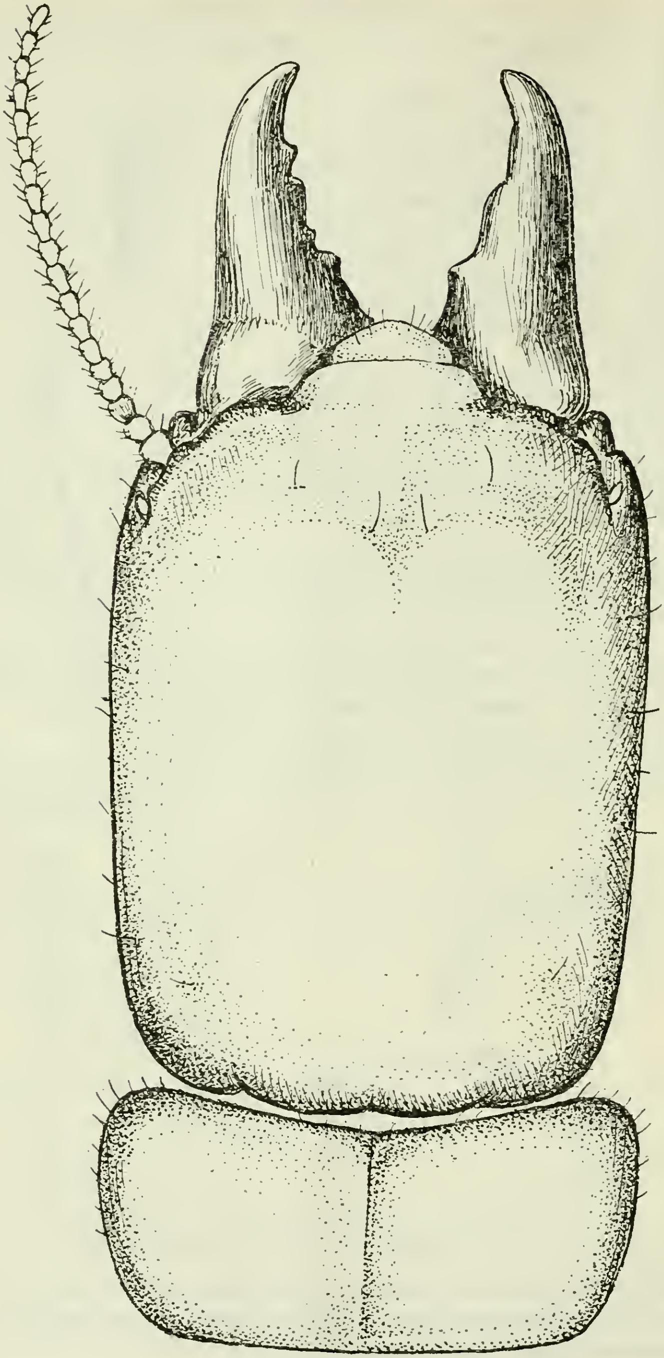


FIG. 22.—NEOTERMES CASTANEUS. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER, SHOWING ARRANGEMENT OF MARGINAL TEETH ON MANDIBLES AND ANTENNAE. (NOTE SIMPLE THIRD JOINT OF ANTENNAE.) × 20.

In some specimens the jaws are nearly as long as width of the head, and more sharply pointed, the head proportionally a little longer, the pronotum rather more narrowed behind, otherwise about the same.

It was described from Porto Rico and "Kalifornien" (San Francisco); no other specimens from California have come to hand, and it is probable that there was a mistake in the label, or it was intended for Lower California.

Occurs in Porto Rico, Kingston, Jamaica, and southern Florida, both on the mainland and offshore keys or reefs. Adam Key (coral reef), Paradise Key (Lower Everglades), Cocoanut Grove, Miami Beach, all in Dade County. (Fig. 21).

Genus CRYPTOTERMES Banks.

Winged.—Very similar to *Kalotermes*, but the wing has the median vein bent up to unite with the radial sector beyond middle of wing; in some forms the median is almost obsolete and the cubitus is bent up and almost united to the radial sector near tip of wing.

Soldier.—The head is but little longer than broad, but extremely high or thick, the front part as high as elsewhere, and with a great cavity in the front. The mandibles are bent near middle and each armed with a tooth beyond middle in a like manner; tibia with three apical spines; cerci indistinct; femora not enlarged.

KEY TO SPECIES.

Winged.

1. Head pale; median vein bent up toward radial sector.......................*cavifrons*.
Head dark; median vein faint or absent, cubitus bent up toward radial sector. *infumatus*.

CRYPTOTERMES CAVIFRONS Banks.

Winged.—Dull pale castaneous; antennae and legs very pale; wings hyaline, costal veins castaneous; tips of mandibles black. Head a little longer than broad; slightly narrowed behind; labrum large, broadly rounded on tip; eyes circular, less than diameter from lower margin of head, about one and a half their diameter from hind margin; ocelli large, subtriangular; adjoining eyes above, their inner ends almost pointed; antennae much longer than head, 15-jointed; third joint not different from second or fourth; pronotum much less than twice as broad as long, about as broad as the head, broadest in middle, rather narrowed in front; front margin nearly straight across, barely concave; hind border also nearly straight, lateral margins with strong hairs. Wing scale about the length of the pronotum. (Pl. 3, fig. 2.) Wings rather long, the abdomen reaching only about one-half way out; radial sector with about three branches to the costa; other venation indistinct; median vein meets radial sector at about origin of

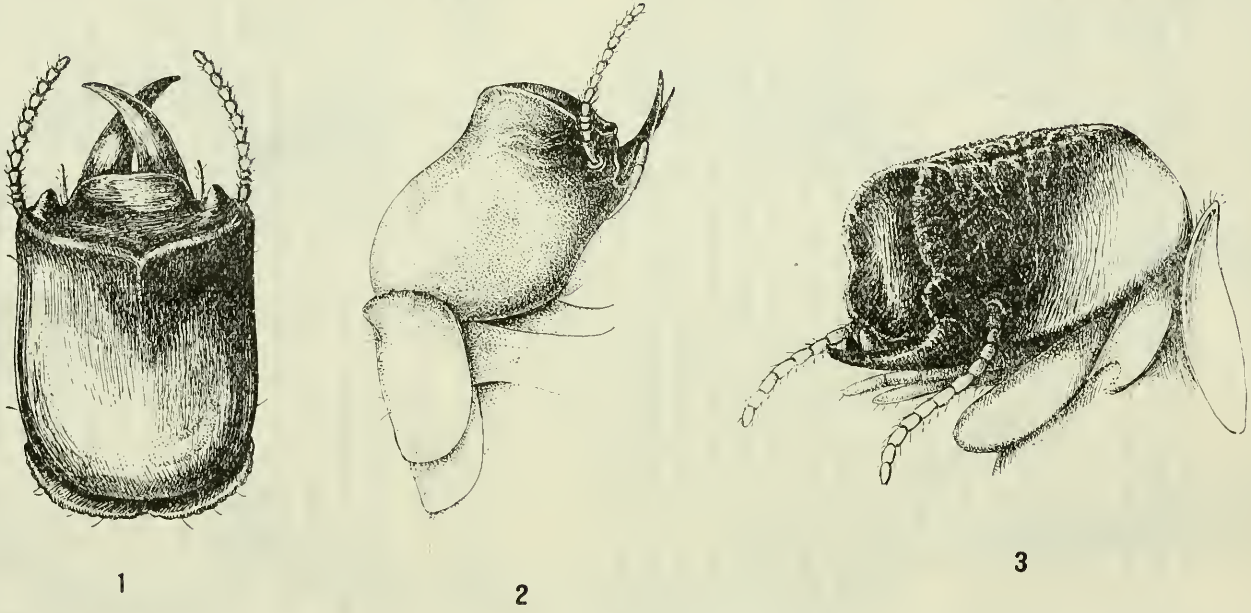


FIG. 23.—1. CRYPTOTERMES CAVIFRONS. DORSAL VIEW OF HEAD OF SOLDIER. × 50. 2. CRYPTOTERMES CAVIFRONS. LATERAL VIEW OF HEAD AND PROTHORAX OF SOLDIER. (NOTE SMOOTH OUTLINE OF HEAD.) × 50. 3. CRYPTOTERMES BREVIS. LATERAL VIEW OF HEAD OF SOLDIER TO SHOW TUBERCULATE OUTLINE. × 40.

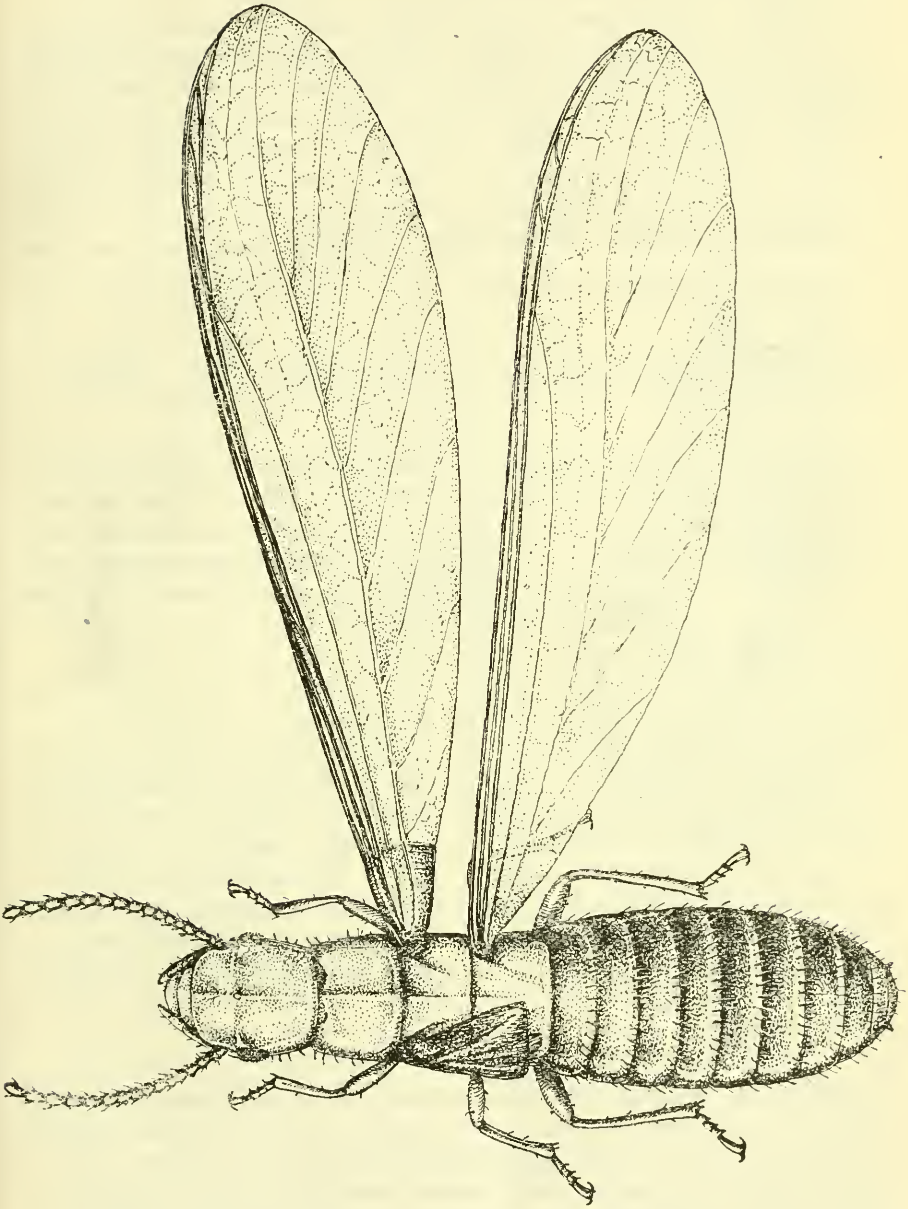
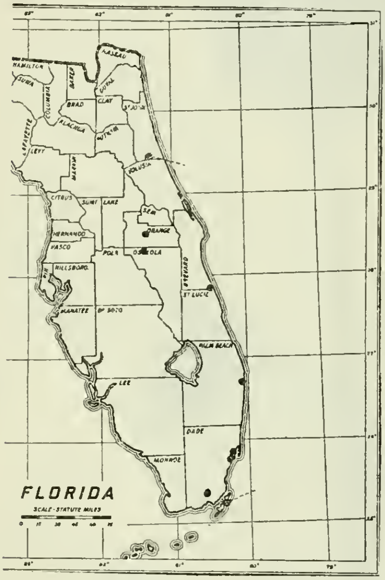


FIG. 24.—CRYPTOTERMES CAVIFRONS. DORSAL VIEW OF SEXUAL, WINGED ADULT. × 24.

the first branch to costa; the cubitus runs out nearly straight toward tip of wing, not bending upward.

Length, to tip of wings, 8.5 to 9 mm. (Fig. 24.)

Soldier.—Head black in front, reddish behind, rest of body brownish yellow; legs pale yellowish, antennae nearly white, mandibles black. Head short, heavy, from above about as broad as long, from side about one and a third times longer than high; in front is a large cavity, margined by a ridge which rises on each side from in front of the antennae; from above, the head is bilobed in front; the upper surface is smooth, only faintly roughened in front toward the cavity; mandibles, from side, not as long as height of head, each jaw bent near the middle and there showing an outer hump, on the inner edge beyond the bend there is on each jaw a large tooth. Antennae hardly as long as height of head, 13-jointed. Pronotum about one-half as long as the head above, less than twice as broad as long; anterior margin angularly emarginate, elevated; the lateral parts slightly rugose, posterior sides rounded into the convex hind margin.


NASSAU
HAMILTON
SUWA
COLUMBIA
BAKER
DUVAL
BRAD
CLAY
ST JOHN
ALACHUA
PUTNAM
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LEVY
MARION
VOLUSIA
CITRUS
SUMT
LAKE
SEM
ORANGE
HERNANDO
PASCO
POLK
OSCEOLA
BREVARD
HILLSBORO
ST LUCIE
MANATEE
DE SOTO
PALM BEACH
LEE
DADE
MONROE
FLORIDA
SCALE-STATUTE MILES

FIG. 25.—DISTRIBUTION OF CRYPTOTERMES CAVIFRONS.

Length, 3.5 to 4.5 mm. (Fig. 23, 1 and 2.)

Occurs only in Florida, being found on both the mainland and offshore reefs. Adam Key (coral reef); Long and Paradise Keys, in the Lower Everglades, Cocoanut Grove, all in Dade County; Palm Beach; Kissimmee, in Osceola County; along the Indian River near the Sebastian River; and as far north as Haw Creek, in St. John County. (Fig. 25.)

CRYPTOTERMES INFUMATUS, new species.

Winged.—Head chestnut brown, paler in front and below; antennae slightly brownish; pronotum very dark, rich shining brown, almost black; femora and tibia chestnut brown, tarsi paler; abdomen chestnut brown. Wings brownish, costal vein darker. Eye circular, a little more than its diameter from lower margin of head; ocelli rather elongate, close to eye; antennae broken; first joint moderately long, second and third joints not much shorter than others, gradually longer and larger. Pronotum hardly twice as broad as long, broadest in middle, concave on front margin, sides rounded. Wings more than twice the length of abdomen, but not twice the length of entire body; no distinct median vein; the cubitus bends upward and meets the radial sector a little before tip of wing.

Length to tip of wings, 11 mm. (Pl. 1, fig. 1.)

From Cotulla, Texas, April 17 (Pratt). Only one specimen, but distinct by the remarkable venation which is similar to an Australian species of the genus.

Type, winged adult.—Cat. No. 21860, U.S.N.M.

Subfamily RHINOTERMITINAE.

KEY TO GENERA.

Winged.

1. Median vein absent, fontanelle nearer to clypeus than to vertex...*Prorhinotermes.*
   Median vein distinct, fontanelle as near to vertex as to clypeus.....*Reticulitermes.*

Soldiers.

1. Labrum pointed at tip; head barely if any broader behind, last tarsal joint moderately long; fontanelle not especially distinct........................*Reticulitermes.*
   Labrum rounded at tip; head plainly broader behind than in front; last tarsal joint very long; fontanelle very distinct.......................*Prorhinotermes.*

Genus PRORHINOTERMES Silvestri.

Winged.—In general similar to *Reticulitermes:* the clypeus and antennae about the same; the fontanelle is very distinct and situated a little nearer to clypeus than to vertex; the wings are similar, but there is no distinct median vein; in the apical part there is an irregular series of connecting veinlets across the cross-veinlets from cubitus to radial sector. The last tarsal joint is rather longer than usual. The gula is broader than long and rounded at the base. Legs hardly reach beyond tip of body; the tibia with two spines at tip.

Soldier.—Head rather broader behind than in front; fontanelle very distinct; mandibles slender, curved, untoothed; labrum not narrowed toward tip, which is rounded; pronotum broadest in front, rounded behind; legs very slender. This species has been placed by Holmgren in *Arrhinotermes,* but the type of *Arrhinotermes,* as admitted by Holmgren, does not belong to this genus, but to *Coptotermes. Prorhinotermes,* although based on an Australian insect, appears to cover our species.

PRORHINOTERMES SIMPLEX Hagen.

Winged.—Head pale reddish brown, yellowish on lower part; thorax and abdomen yellowish brown; legs and antennae pale. Head no longer than broad, but little broader behind than in front; eyes circular, less than diameter from the lower margin of head, a little over twice their diameter from the hind margin of head; fontanelle distinct, circular, on a line joining the middle of eyes; antennae longer than head (12 joints as long as head).

Pronotum twice as broad as long; front margin straight; sides tapering behind and rounded into the hind margin. Wing scales plainly longer than the pronotum. Wings more than twice as long as the abdomen, hyaline; the costal veins yellowish, base slightly blackish; the cubitus forks before middle of wing, and with about seven branches before the fork. (Pl. 4, fig. 1.) Head and thorax with few erect hairs, many erect hairs on dorsum of abdomen. Length to tip of wing, 9 mm. (Fig. 27.)

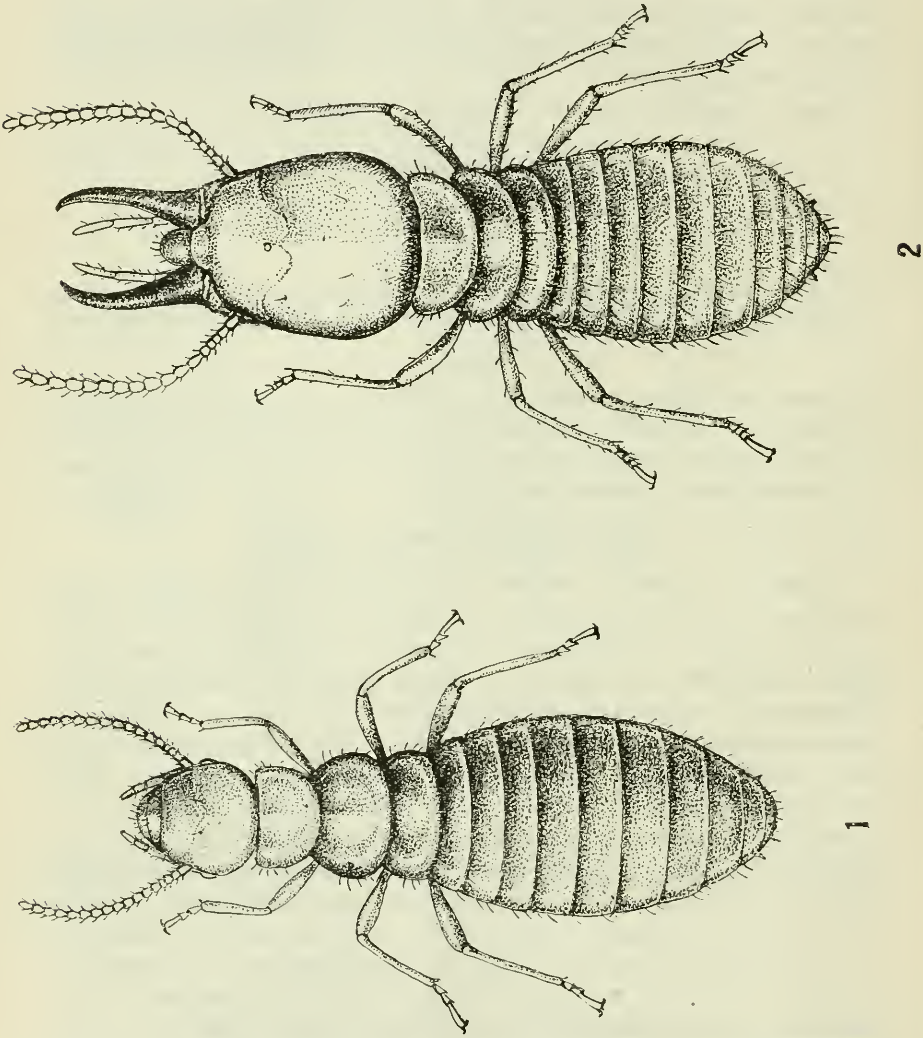

Fig. 26.—1. Prorhinotermes simplex. Dorsal view of worker. × 20. 2. Prorhinotermes simplex. Dorsal view of soldier. × 20.

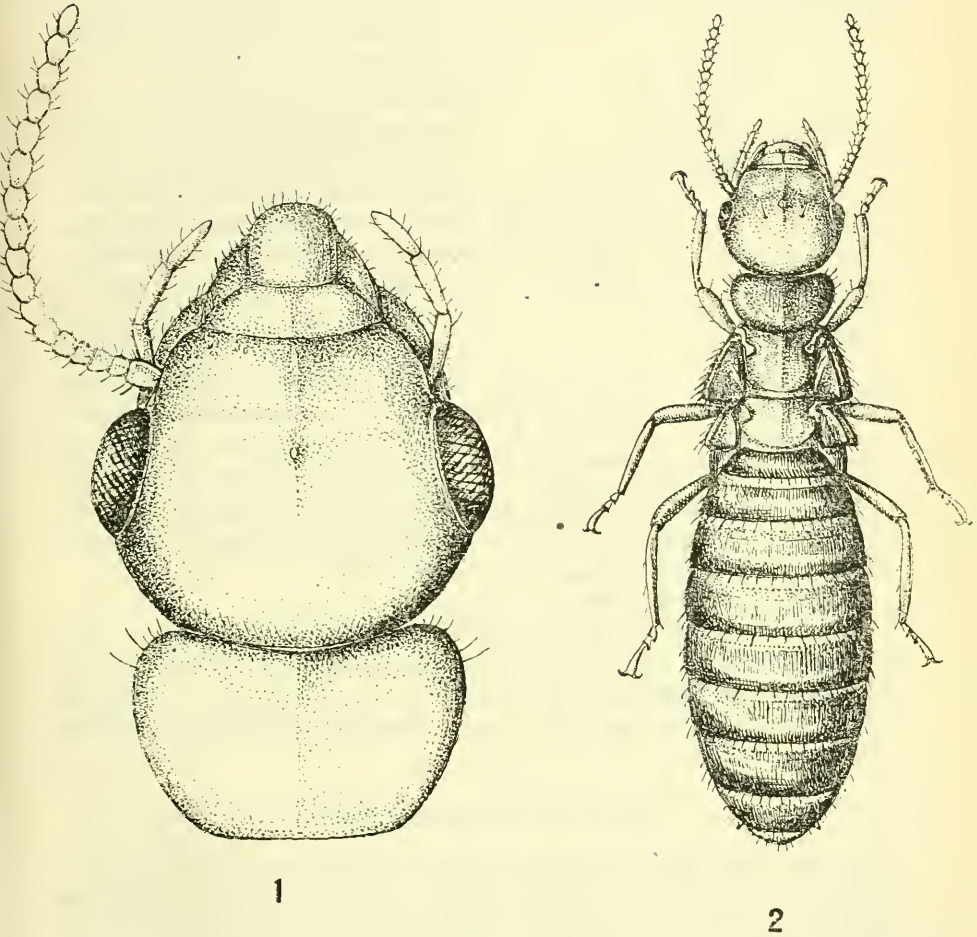

FIG. 27.—1. PRORHINOTERMES SIMPLEX. DORSAL VIEW OF HEAD AND PROTHORAX OF FIRST FORM, SEXUAL, WINGED ADULT. × 40. 2. PRORHINOTERMES SIMPLEX. DORSAL VIEW OF YOUNG FIRST FORM DEÄLATED QUEEN. × 16.

Soldier.—Yellowish; antennae, legs, and venter pale; mandibles, except base, red brown. Head about one and one-third times longer than broad, plainly broader behind than in front; labrum rather narrow, rounded on tip; eyes hyaline; fontanelle very distinct, circular, situated a little behind a line connecting eyes; mandibles as long as width of head at antennae, untoothed, with tips slightly curved; antennae fully as long as head, 17-jointed, the hairs on joints very long; gula about one-half as wide in middle as in front; maxillary palpi very long, nearly as long as the mandibles; legs rather long, femora slender; pronotum nearly two and one-half times as broad as long, broadest near front; anterior margin slightly concave, posterior sides sloping and rounded into the convex hind margin; mesonotum and metanotum with sides rounded into hind margin. Body, legs, and antennae with many rather long white hairs. (Fig. 26, 2.)

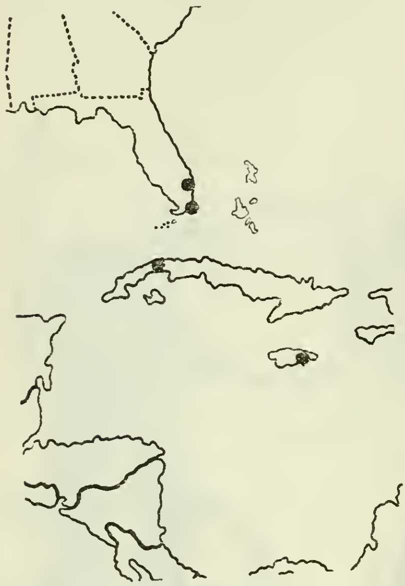

Fig. 28.—Distribution of Prorhinotermes simplex.

Length, 5.5 to 6.5 mm.

Occurs in Cuba (Santiago de las Vegas), Kingston, Jamaica, and southern Florida. In Florida Adam Key (offshore coral reef), Miami Beach, across Biscayne Bay from Miami, and in the vicinity of Homestead are the only localities where this species has yet been found. (Fig. 28.)

Genus **RETICULITERMES** Holmgren.

Winged.—Clypeus very short, nearly four times as broad as long, strongly bilobed; fontanelle indistinct, situate as near vertex as clypeus; eyes nearly circular; ocelli distinct; antennae with joints 2, 3, and 4 very short; gula as broad as long. Pronotum subquadrangular, but the posterior sides more or less narrowed and rounded into hind margin; forewing scales much larger than hind ones, and longer than the pronotum. Wings slender, with many irregular transverse veinlets connecting the longitudinal veins; the median vein distinct, running nearer cubitus than to radial sector; near tip of wing it bends down slightly. Legs reach beyond tip of the body.

Soldier.—Head more or less elongate, about as broad in front as behind; labrum narrowed and pointed at tip; mandibles slender, slightly curved, without teeth; gula narrowed in the middle, much widened in front; a small, hyaline ocellus-like dot is seen above the base of each antenna; fontanelle distinct, situate before the middle of head. Pronotum broadest across front, sides rounded behind, front margin indented in middle; legs moderately slender; body and legs with erect hairs.

KEY TO SPECIES.

Winged.

1.	Color pale brownish yellow	*hageni.*
	Color dark brown to black	2
2.	Tibiae more or less plainly blackened	6
	Tibiae pale as the tarsi	3
3.	Ocelli plainly more than diameter from eyes; wings grayish	*flavipes.*
	Ocelli not more than diameter from eyes	4
4.	Wings grayish; tibiae often slightly blackish; length fully 9 millimeters; western species	*hesperus.*
	Length 10-12 mm.; eastern species	*lucifugus.*
	Wings whitish; tibiae not darkened	5
5.	Ocelli about diameter from eyes; length nearly 10 mm	*claripennis.*
	Ocelli much less than diameter from eyes; length hardly 8 mm.; eastern species	*virginicus.*
6.	Tibiae hardly darkened; anal area largely pale; wings grayish	*hesperus.*
	Tibiae plainly blackish; anal region not or barely pale	7
7.	Length to tip of wings about 10 mm.; color deep black; wings scarcely gray	*tibialis.*
	Length to tip of wing hardly 9 mm., color paler, especially head, wings grayish	*humilis.*

Soldiers.

I am not able at present to tabulate our species, but certain tendencies can be used to distinguish them in most cases, but can not be relied upon in doubtful cases.

KEY TO SPECIES.

1.	Head plainly broader behind	*tumiceps.*
	Head not plainly broader behind	2
2.	Gula less than twice as broad in front as in middle	*tibialis.*
	Gula fully twice as broad in front as in middle	3
3.	Head fully twice as long as broad; California species	*hesperus.*
	Eastern species	*lucifugus.*
	Head less than twice as long as broad	4
4.	Head more hairy than usual	*humilis.*
	Mandibles plainly longer than width of head	var. *hoferi.*
	Head moderately hairy	5
5.	Mid-western species	*claripennis.*
	Eastern species	6
6.	Larger species	*flavipes.*
	Smaller species	*virginicus* and *hageni.*

RETICULITERMES HAGENI, new species.

Winged.—Pale yellowish brown; coxae, femora, and pleura much darker brown; antennae brown, palpi wholly pale. Head plainly broader than in *R. virginicus;* the eyes of the same size, fully their diameter from the lower margin; the ocelli scarcely their diameter from the eyes; the median groove ends in the punctiform fontanelle a little before hind border of eyes; lateral and median spots of head distinct, laterals semilunar, the median transverse. Pronotum as broad as in *R. virginicus*, but plainly longer; not as broad as width of head between eyes, hind border plainly bilobed, anterior margin slightly concave, and with a median incision. Abdomen is similar to *R. virginicus,* but in the male the hind edge of both the fifth and sixth ventral segments is plainly concave. Body clothed with pale hair, that on head also pale. Wings hyaline, not grayish. Length to tip of wings, 8 mm. In vicinity of Washington, *hageni* flies the latter part of July or early in August.

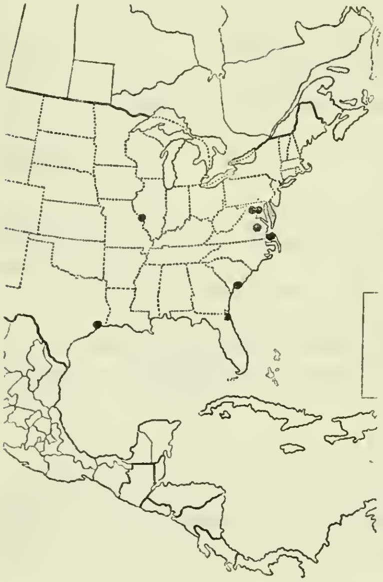

FIG. 29.—DISTRIBUTION OF RETICULITERMES HAGENI.

Soldier.—Head about one and three-fourths times as long as broad, sides parallel, a little shorter than in *R. flavipes* and plainly more narrow, of a very pale yellowish color, darker in front, paler than any other of our species; the ocellar spots scarcely if at all visible; gula about two and one-half times as broad in front as at narrowest part; mandibles as long as width of the head. Pronotum narrower than the head, slightly emarginate in middle in front; cerci and stylets about as in *R. flavipes*.

Occurs from Florida (Jacksonville, Apr. 29) to Maryland west to Illinois and Texas. In South Carolina at Charleston, in Charleston County; in Virginia at Lake Drummond, Dismal Swamp, Norfolk County, Richmond, in Henrico County, Falls Church, Chain Bridge, and Great Falls (Fairfax County). In Maryland at Bladensburg, Prince Georges County; at Washington, District of Columbia; at Kane, Greene County, Illinois; and Harrisburg, Harris County, Texas. (Fig. 29.)

On October 30, 1918, near Houston, Texas, H. S. Barber found a pair of deälated adults of this termite. These two specimens may be a variety of *R. hageni*, but are so close in most ways that they can not be considered a separate species without more specimens. The head is plainly more narrow and the antennae darker.

Type, winged adult and soldier.—Cat. No. 21863, U.S.N.M.

RETICULITERMES FLAVIPES Kollar.

Winged.—Hard parts brown to blackish, always darker on head and thorax than on the abdominal segments; legs beyond femora whitish; last joint of palpi barely if at all marked with dark. Head about as broad as long; margin of labrum a little emarginate; eyes about circular, each about its diameter from the lower margin; ocelli more than diameter from eye, and as far from the lateral fenestrae; latter semielliptic, fairly distinct, and much larger than the intermediate ones, which are faint; hair of vertex black, and nearly as long as diameter of an eye; the pronotum about as broad as head, and about as broad behind as long, only barely emarginate behind; antenne 16 to 18-jointed. Body, legs, and wing scales clothed with pale, rather yellowish hair. Wings with a distinct grayish tinge.

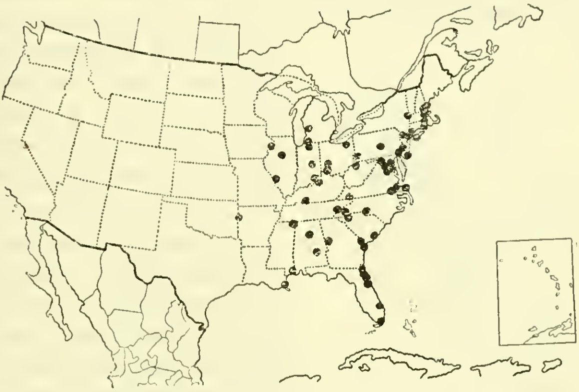

FIG. 30.—DISTRIBUTION OF RETICULITERMES FLAVIPES.

Length to tip of wings, 10 mm.

Soldier.—Head about one and one-half times as long as broad in front, plainly broader in front than elsewhere; sides nearly straight and tapering to the broadly rounded posterior side, surface with scattered erect hairs about as long as first joint of antenna; antenna 16-segmented; maxillary palpi slender, the last three joints subequal; mandibles about as long as width of head; gula about two and a half times as broad in front as at middle. Pronotum nearly semicircular, the front margin slightly indented in middle, the surface with numerous erect hairs; body and legs with similar hairs.

I have examined cotypes of Kollar.

From most of the Eastern United States, east of the Mississippi River, Kittery, Maine to Long Key (Lower Everglades) Florida, and in Matamoras (Tamaulipas, Mexico), except certain places in extreme north, also is not so common in extreme south. This species occurs as far west as St. Louis, Missouri and Van Buren (Crawford County), Arkansas. The southern shores of the Great Lakes, or rather the Superior Highlands, appear to be a northern limit of this species. West of the Mississippi it occurs in Texas, Arkansas, Missouri; flying in spring before *R. virginicus;* however there are various cases of fall flights. (Fig. 30.)

RETICULITERMES VIRGINICUS Banks.

Winged.—Hard parts rich, dark, shining, castaneous; the abdominal plates about as dark as head; legs beyond femora whitish. Head a little longer than broad, median groove extending to the punctiform fontanelle, which is almost on a line connecting the hind margins of the eyes; eyes hardly circular, a little projecting on side toward cheeks, a little less than diameter from the lower margin; ocelli less than diameter from eyes. Pronotum much narrower than head, not broader than distance between eyes; rather strongly bilobed behind. Body, legs, and wing scales clothed with pale hair; that on the head darker. Wings hyaline, plainly a little whitish.

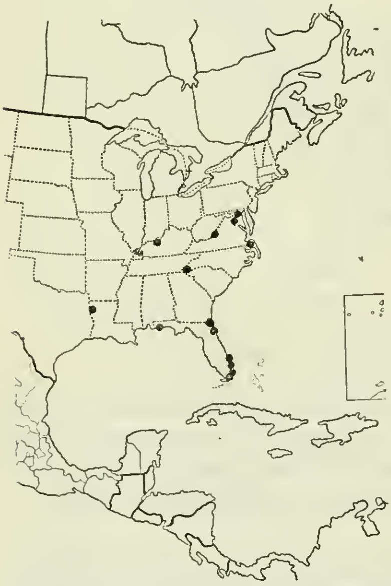

FIG. 31.—DISTRIBUTION OF RETICULITERMES VIRGINICUS.

Length to tip of wings, 8 mm.

Soldier.—Head about the same proportions as in *R. flavipes*, but smaller throughout, being shorter and narrower. The mandibles as in *R. flavipes*, and apical segments also; the cerci perhaps a little smaller in proportion; the maxillary palpi are about as long as in *R. flavipes*, so come much nearer to reaching the tip of the mandibles; antennae of about 16 segments.

Occurs from Baltimore and Westminster (Carroll County), Maryland, south to Paradise Key, Florida, in the Lower Everglades, and west to Kentucky (Okolona, near Louisville in Jefferson County), and Louisiana, (Shreveport, Caddo Parish). (Fig. 31.)

Swarms about a month later than *R. flavipes;* it does not extend as far north or west as that species and is less common.

RETICULITERMES CLARIPENNIS, new species.

Winged.—The color of the head and thorax is darker than in *R. flavipes;* femora black, rest of legs pale; palpi pale. The head is a trifle broader than in *R. flavipes,* the lateral and intermediate spots hardly discernible; the fontanelle a trifle farther back than in *R. flavipes;* ocelli usually fully a diameter (but not more) from the eyes. Pronotum hardly as much narrowed behind as in *R. flavipes,* slightly emarginate on hind border. In the male the last ventral segment is proportionately longer than in *R. flavipes.*

Length to tip of wings, 9.5 to 10 mm.

Soldier.—Closely similar to *R. flavipes,* but the head is more slender, the sides more nearly parallel, and consequently the gula more elongate, the ocellar spot is faint. This had been considered the European *R. lucifugus;* but the wings are clearer, and there is no reason why *lucifugus* should occur in central parts of the United States.

Occurs from Manhattan (Riley County), Kansas, south to Brownsville (Cameron County), Texas, west to Austin (Travis County), New Braunfels (Comal County) and Uvalde (Uvalde County), and Tucson, Arizona, and east to Beaumont (Jefferson County), Texas; also in Monterey, Mexico. (Fig. 32.)

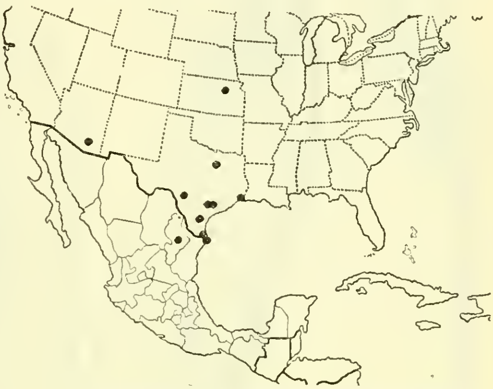

FIG. 32.—DISTRIBUTION OF RETICULITERMES CLARIPENNIS.

Type, winged adult.—Cat. No. 21862, U.S.N.M.

RETICULITERMES TIBIALIS, new species.

Winged.—Almost wholly shining blackish, only the mouthparts, tarsi and tips of tibiae pale, bases of wings blackish; last joint of palpi marked with dark. Head about as long as broad, front margin slightly concave; eyes about their diameter from the lower margin, ocelli a little less than diameter from the eye; lateral spots indistinct or absent; the antennae 16-jointed. Pronotum as wide as space between eyes, slightly concave in front, and plainly indented behind in the middle, hardly as much narrowed behind as in the other species. Body with hair as in other species.

Its black color, blackened tibiae, and rather broad head and pronotum, easily separate it from our eastern species. There are flying records for both spring and fall.

Length to tip of wings, 9.5 to 10 mm. (Fig. 33.)

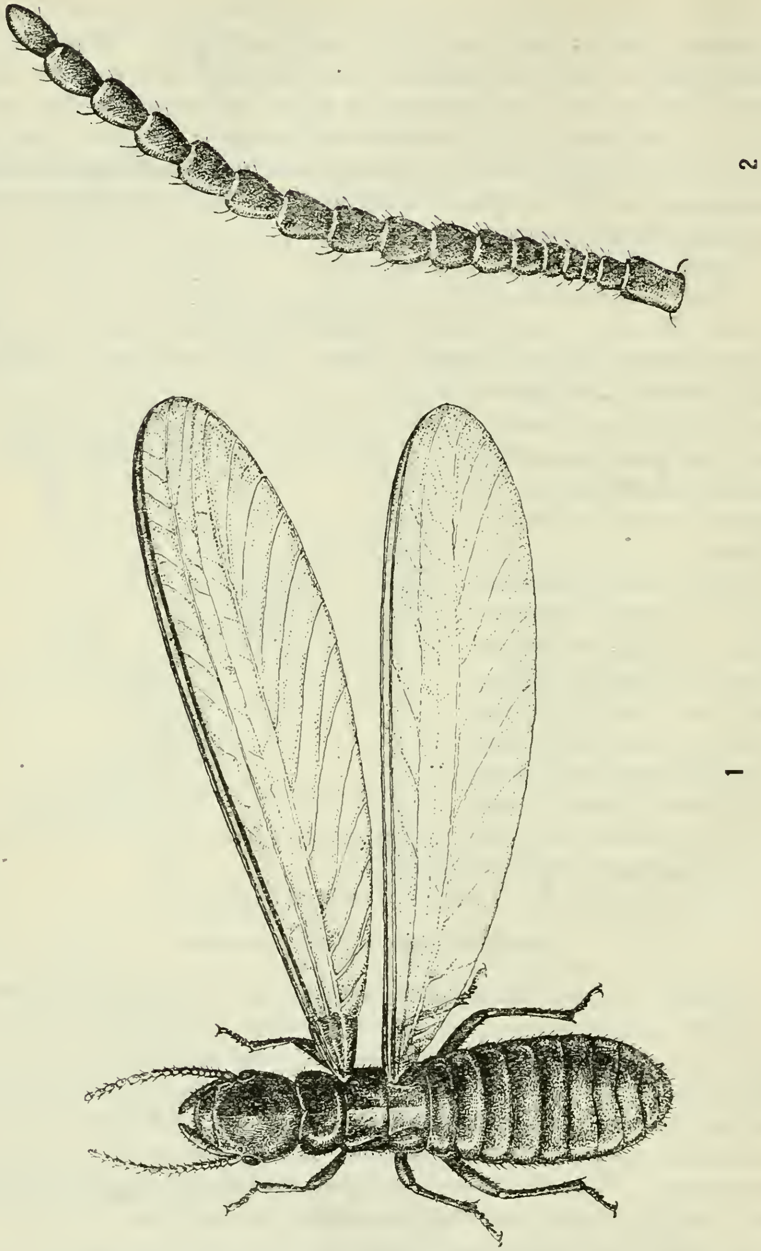

Fig. 33.—1. Reticulitermes tibialis. Dorsal view of sexual, winged adult. × 19. 2. Reticulitermes tibialis. Antenna of sexual, winged adult. × 72.

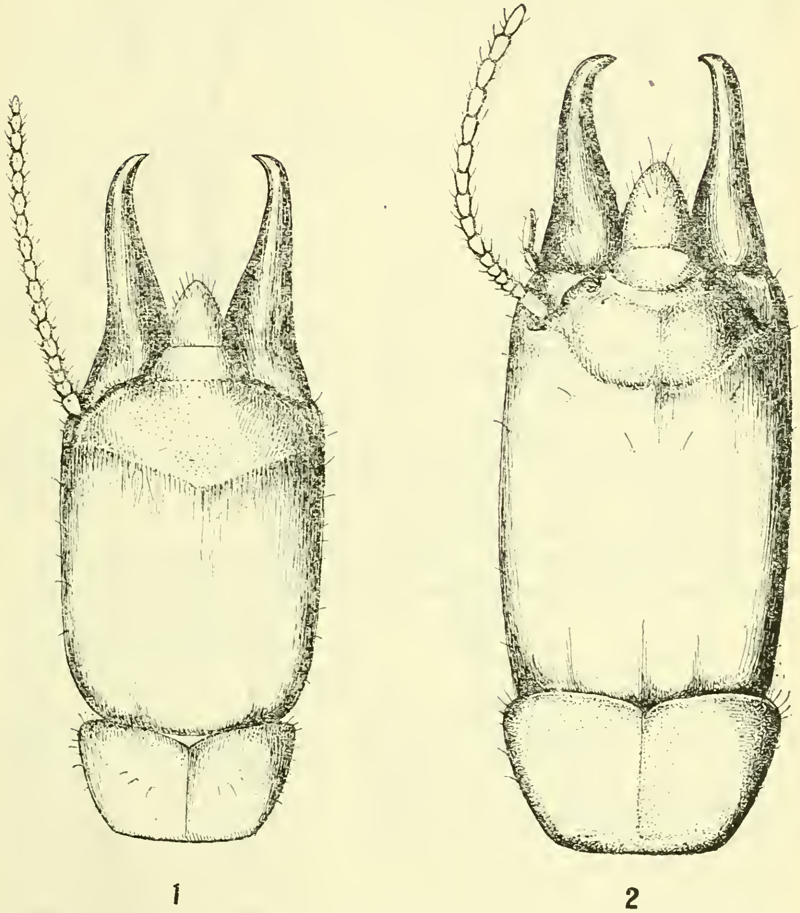

FIG. 34.—1. RETICULITERMES TIBIALIS. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER. × 40.
2. RETICULITERMES HESPERUS. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER. × 40

Soldier.—Head about on the same proportions as in *R. flavipes*, about one and one-half times as long as broad, the sides nearly parallel, not broader in front, of a rather dull brownish yellow; ocellar spot usually faintly visible; mandibles about as long as width of the head; pronotum much narrower than head, slightly emarginate in middle of front; cerci and stylets rather smaller than in *R. flavipes*. On the under surface of the head the gula is plainly wider than in the other species, in the narrowest part it is about one-half as wide as in the front. (Figs. 35, *b* and 34, 1.)

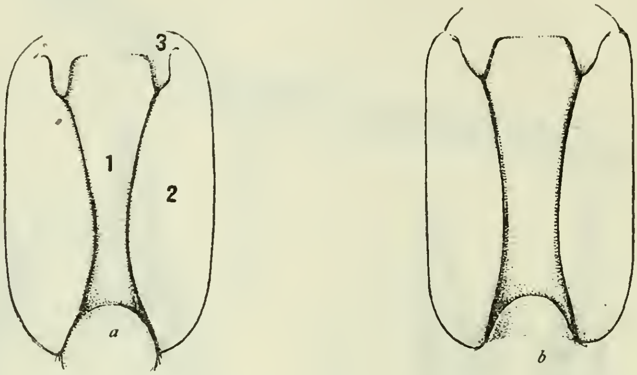

Fig. 35.—Contrasting views of gula (ventral). 1. Gula. 2. Gena. 3. Hypostoma. (*a*) Reticulitermes flavipes. (*b*) Reticulitermes tibialis. Greatly enlarged.

Common through much of the west, being recorded from as far east as Iowa City (Johnson County), Iowa and Cass (Franklin County), Arkansas. The State records are Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Nevada, Utah, Idaho, Montana, and California. (Fig. 36.)

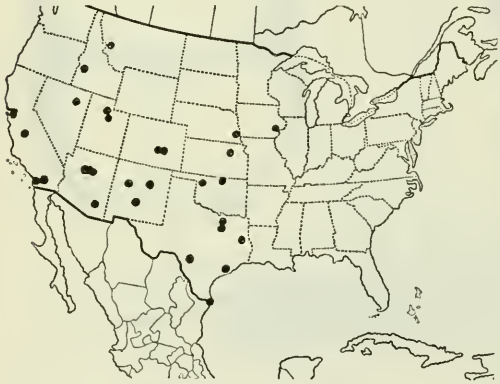

Fig. 36.—Distribution of reticulitermes tibialis.

Type, winged adult.—Cat. No. 21861, U.S.N.M.

RETICULITERMES HESPERUS, new species.

Winged.—Brown, about as in *R. flavipes*. The tibiae are often a trifle darkened, but not as black as in *R. tibialis;* the anal area usually shows a paler yellowish spot, more prominent than in *R. tibialis*. The wings are distinctly darkened, fully as dark as in *R. flavipes;* antennae and palpi dark. The ocelli are close to eyes, less than a diameter distant. Pronotum smaller and narrower than *R. flavipes*.

The last ventral segment of female is proportionally longer than in *R. tibialis.*

Length to tip of wings, 8–9 mm.

Soldier.—Head from nearly twice as long as broad to much more than twice as long as broad; about as broad as in *R. flavipes,* but nearly one-third longer; color as in other species. Pronotum slightly emarginate in front in middle, narrowed behind; gula fully two and a half times as broad in front as at the narrowest part. (Fig. 34, 2.)

Occurs from southern California (Campo, along the boundary line of lower California), north through Oregon to Washington (Spokane), east to Nevada (Elko). (Fig. 37.)

Type, winged adult.—Cat. No. 21864, U.S.N.M.

RETICULITERMES HUMILIS, new species.

Winged.—Closely similar to *R. tibialis*; tibiae more or less infuscated, the antennae and palpi marked with dark; the ocelli a little less than its diameter from eye, the eye hardly its diameter from the lower margin of head; the head is a trifle shorter, and the pronotum a little more narrowed behind than in *R. tibialis,* and the whole insect is a little smaller than that species; the wings are slightly grayish, the color of the body paler than *R. tibialis,* and the head especially brown.

Length to tip of wings, scarcely 9 mm.

Soldier.—Smaller and with more slender head than *R. flavipes.* Head about twice as long as broad, sides parallel, with more numerous erect hairs than usual; mandibles as long as width of head; gula slender, more than twice as wide in front as at narrowest part; the ocellus-like spot above base of antenna very distinct; the labrum is hardly as pointed at tip as in *R. flavipes.* The pronotum about as long as usual, but a trifle more narrowed behind, deeply notched in front. The femora appear slightly more swollen than in *R. flavipes.* In general it is very close to *R. hesperus,* but the soldier has less elongate head, more hairy above; the imago has the tibiae darker; anal area less pale, and the last ventral segment of male not so long. (Fig. 38, 1.)

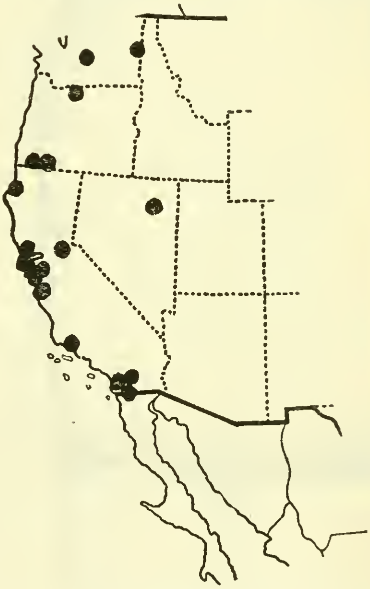

FIG. 37.—DISTRIBUTION OF RETICULITERMES HESPERUS.

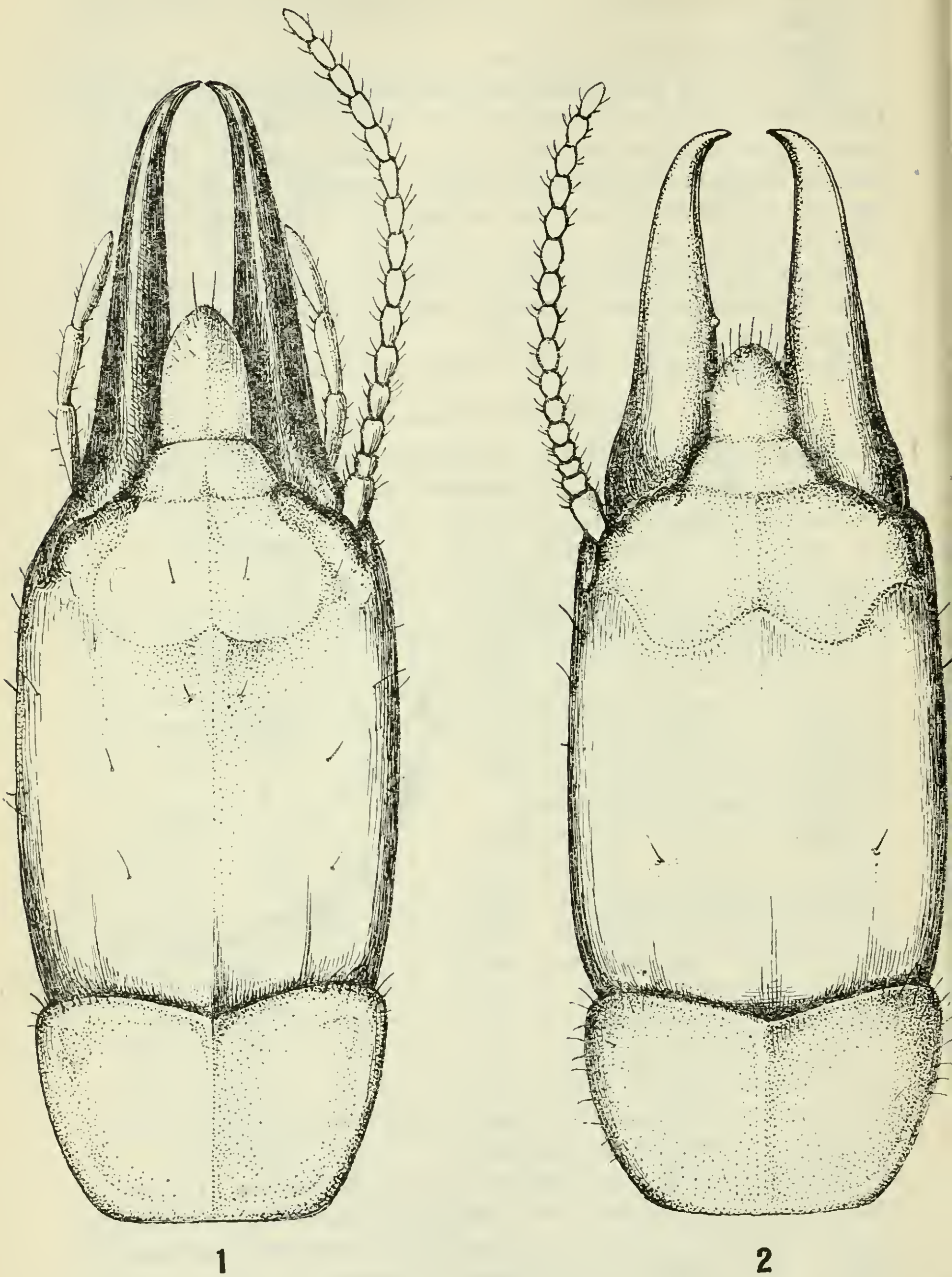

Fig. 38.—1. Reticulitermes humilis. Dorsal view of head and prothorax of soldier. × 40. 2. Reticuliterm tumiceps. Dorsal view of head and prothorax of soldier. × 40.

Occurs only in Arizona, from Nogales, on the Mexican border, and Palmerlee (Huachuca Mountains); north of the Santa Rita Mountains; Tucson, Catalina Springs, and the Santa Catalina Mountains (Sabino Canyon), in Pima County; Oracle (Pinal County), in the Pinaleno Mountains (Grant Canyon and Post Canyon), at an elevation as high as 8,000 feet, in Graham County; and as far north as Flagstaff and Williams, in Coconino County. (Fig. 39.)

Type, soldier.—Cat. No. 21865, U.S.N.M.

RETICULITERMES HUMILIS Banks, var. HOFERI, new variety.

Soldier.—Differs from *humilis* in rather smaller head, in having the gula as wide or a little wider than typical form, but noticeably in the much longer, more slender mandibles; these are plainly longer than the width of the head.

Soldiers only known from Nogales, (T. E. Snyder, Coll.), and Sabino Canyon, Santa Catalina Mountains, Arizona (Geo. Hofer, Coll.).

Type, soldier.—Cat. No. 21866, U.S.N.M.

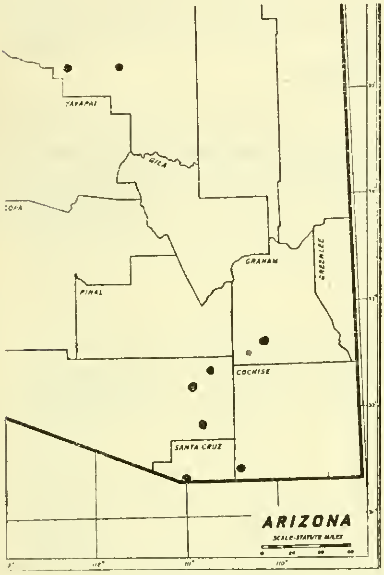

Fig. 39.—Distribution of Reticulitermes humilis.

RETICULITERMES TUMICEPS, new species.

Soldier.—Similar to *R. tibialis*, rather larger, the gula usually a little more slender, but still broader than in many species; head about one and a half times as long as broad in front, but plainly broader behind than in front, especially noticeable when seen from beneath; mandibles about as broad as head in front; hairs fairly numerous; labrum about as in *R. tibialis*. Pronotum considerably narrowed behind, but little indented in front; the femora are rather more swollen than in *R. tibialis*. (Fig. 38, 2.)

Although I can not associate a winged form with these soldiers, the shape of head induces me to think that they represent a new species.

Stratton, Santa Catalina Mountains, Arizona, 6,000 to 7,000 feet, 27 July, 1917 (W. M. Wheeler).

Type, soldier.—Cat. No. 10543, M.C.Z.

RETICULITERMES LUCIFUGUS Rossi.

Colonies of this European species have recently been found at Stony Brook and other localities near Forest Hills, Massachusetts, by Mr. R. J. Dobson. It is closely similar to the *R. hesperus* of California in size and color of wings; the ocelli are, however, plainly separated from the compound eye (in *hesperus* practically touching the eye) and the basal joint of the antenna appears to be shorter than in that species.

R. lucifugus matures later than *R. flavipes;* winged adults were taken from a colony on June 9, 1918. The adults from this colony had not yet swarmed this year.

Subfamily TERMITINAE.

KEY TO GENERA.

Adults.

1. No ocelli; clypeus three times as broad as long.......... *Leucotermes.*
   Ocelli present.......... 2
2. Front tibia with an outer as well as two inner apical spines; fontanelle very distinct.......... *Amitermes.*
   Front tibia with only the inner pair of apical spines.......... 3
3. Third joint of antennae plainly longer than the second or fourth.. *Constrictotermes.*
   Third joint not longer than second.......... 4
4. Fontanelle hardly visible; mandibles more elongate than usual..... *Anoplotermes.*
   Fontanelle distinct although small, elongate and somewhat divided below; mandibles of usual length.......... *Nasutitermes.*

Soldiers.

1. No soldier caste.......... *Anoplotermes.*
   Soldier present.......... 2
2. Head nasute.......... 3
   Head not nasute.......... 4
3. Head constricted; legs very long.......... *Constrictotermes.*
   Head not constricted; legs less long.......... *Nasutitermes.*
4. Mandibles with more or less distinct teeth.......... *Amitermes.*
   Mandibles without teeth.......... 5
5. Labrum broad and divided or concave on tip.......... *Eutermes.*
   Labrum pointed at tip.......... *Leucotermes.*

Of *Eutermes* as here defined, with *E. debilis* as type, we have no species in our country, the species previously so recorded going to *Constrictotermes* and *Nasutitermes.*

Workers.

1. Third joint of antennae plainly longer than the second; head dark; right mandible with three distinct teeth; maxillae with inner tooth halfway out on outer process.......... *Constrictotermes.*
   Third joint of antennae not longer than second..........2.
2. Antennae 15 or 16-jointed; head whitish.......... *Leucotermes.*
   Antennae 13 or 14-jointed..........3.
3. Right mandible with three distinct teeth..........4.
   Right mandible with but two distinct teeth; inner lobe of maxillae broader, rounded on tip, with bristles or slender spine.......... *Amitermes.*
4. Inner lobe of maxillae narrow, pointed at tip, with stout spines...... *Anoplotermes*
   Inner lobe of maxillae broad, rounded on tip, with fine hairs.... *Amitermes* (part).

Genus AMITERMES Silvestri.

Winged.—Clypeus bilobed, about two and a half times as broad as long, about as long as distance from ocelli to clypeus; fontanelle minute, elongate, hyaline, or nearly circular; antennae with joints 2, 3, and 4 short and small. Legs reach beyond tip of body, front tibia with two small inner spines at tip and one outer one. Front wing scales very short; wings very long and narrow, margins ciliate, the membrane not distinctly hairy; median runs near to cubitus and usually forks near middle.

Soldier.—Head but little longer than broad, convex above; clypeus bilobed; labrum nearly pointed; mandibles curved, with one tooth; palpi rather long; gula slightly narrowed in front, wide in middle; pronotum diamond-shaped, sides bend downward, legs moderately slender.

KEY TO SPECIES.

Soldiers.

1. Mandibles as long as the head..2.
Mandibles very much shorter than the head..3.
2. A distinct tooth much before the middle of each mandible..........*arizonensis.*
A little hooklike tooth near middle of each mandible..................*tubiformans.*
3. Mandibles thick and stout, with blunt tooth; larger species..........*californicus.*
Mandibles slender, with sharp tooth; smaller species......................*wheeleri.*

Winged.

1. Length not over 10 mm..2.
Length fully 12 mm; fontanelle nearly circular..4.
2. Fontanelle very slender and elongate..3.
Fontanelle large and broad, but longer than broad, larger than an ocellus *californicus.*
3. Head black..*tubiformans.*
Head brown..*arizonensis.*
4. Clypeus pale; head pale brown..*confusus.*
Clypeus dark; head darker brown..*perplexus.*

Of the last two species we have seen only adults, and the shape of the fontanelle might indicate that they do not belong to *Amitermes* but to *Capritermes.*

AMITERMES TUBIFORMANS Buckley.

Winged.—Brown, the head dark brown, clypeus paler, antennae with brown, legs dull yellowish to brown. Head short, broadest at eyes, narrowed in front and behind; eyes round, hardly half their diameter from lower margin of head, ocelli about their short diameter from eyes; fontanelle distinct, elongate, on a line connecting tops of the eyes; antennae longer than head, 14-jointed. Pronotum nearly twice as broad as long, broadest near the front margin which is nearly straight, the sides sloping backward and rounded into the hind margin; wing-scales hardly as long as pronotum. Wings nearly twice as long as body, brownish, costal veins darker, cubitus with about seven branches, median forked beyond middle. Body and legs rather densely short haired.

Length to tip of wings, 9 mm. (Fig 41.)

From Uvalde, Texas, June 25. Head and pronotum blacker than in *A. arizonensis,* which has a more or less yellowish head.

Soldier.—Abdomen gray, legs white, mandibles red brown from beyond basal third; antennae brownish beyond middle, rest yellowish. Head but little longer than broad, a trifle broader behind than in front, sides faintly rounded; labrum with rounded tip, broader than in *A. arizonensis;* mandibles fully as long as head, nearly straight for two-thirds their length then evenly curved inward, more slender than in *A. arizonensis;* a little before the middle there is a hooklike tooth, projecting from the mandible only on inner edge. Gula gradually narrowing from behind forward. Antennae as in other species. Body and legs with fine whitish hairs.

Length of head plus mandibles, 2.4 mm. (Fig. 42, 1.)

From Mexico, Camargo (Busck), and collected by Snyder at various places in Texas as follows: Brownsville, Lloma Alto, Cameron County; Cotulla, Lasalle County; Victoria, Victoria County; San Antonio, Bexar County; Uvalde, Chalk Bluff, and Laguna, Uvalde County; and El Paso, El Paso County; also Arizona, Mesa (Morrill). (Fig. 40.)

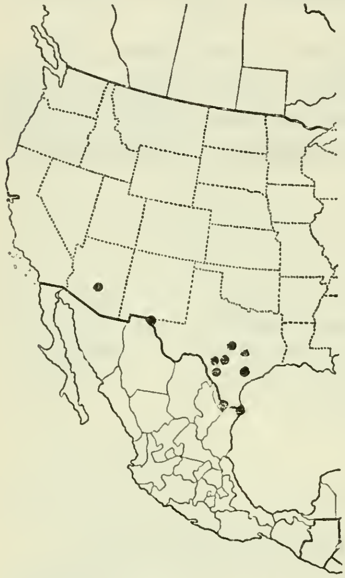

Fig. 40.—Distribution of Amitermes tubiformans.

AMITERMES ARIZONENSIS, new species.

Winged.—Shining light brown; clypeus, mouthparts, legs, pleura, sternum, and venter pale; wings evenly brownish. Body clothed with fine short yellowish hair; that on the head dark. Eyes circular; about one-half their diameter from the lower margin of head, ocelli rather large, slightly longer than broad, and about its short diameter from eye; fontanelle scarcely above a line connecting tops of eyes; antennae about one and a third times as long as width of head, plainly thicker toward tip. Pronotum fully twice as broad as long, broadest in front; sides sloping behind and broadly rounded into hind margin. Wings fully twice as long as entire body; median vein usually forked little beyond middle of wing, each branch divided, and the upper usually twice divided; the cubitus ends a little beyond second third of wing, with five or six branches.

Length, 9 mm.

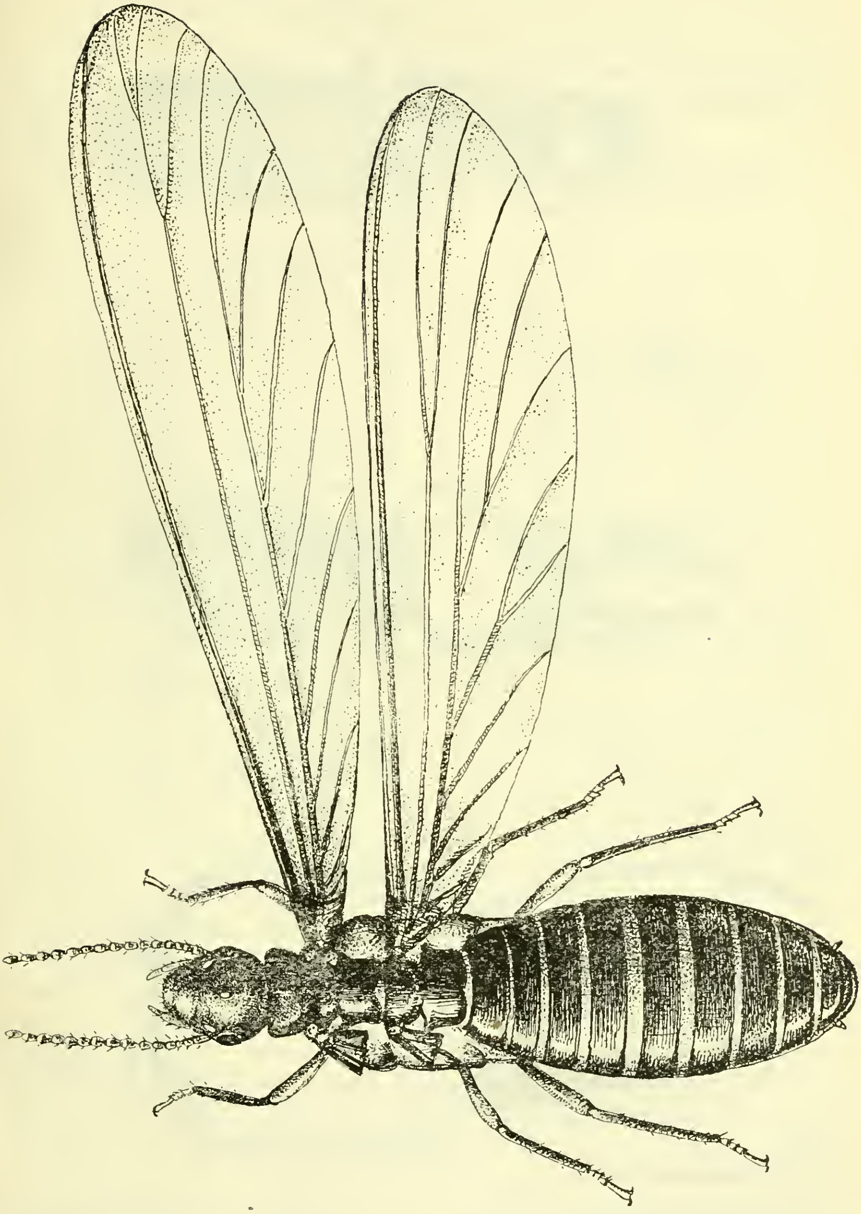

FIG. 41.—AMITERMES TUBIFORMANS. DORSAL VIEW OF SEXUAL, WINGED ADULT, WINGS EXTENDED TO SHOW VENATION. × 20.

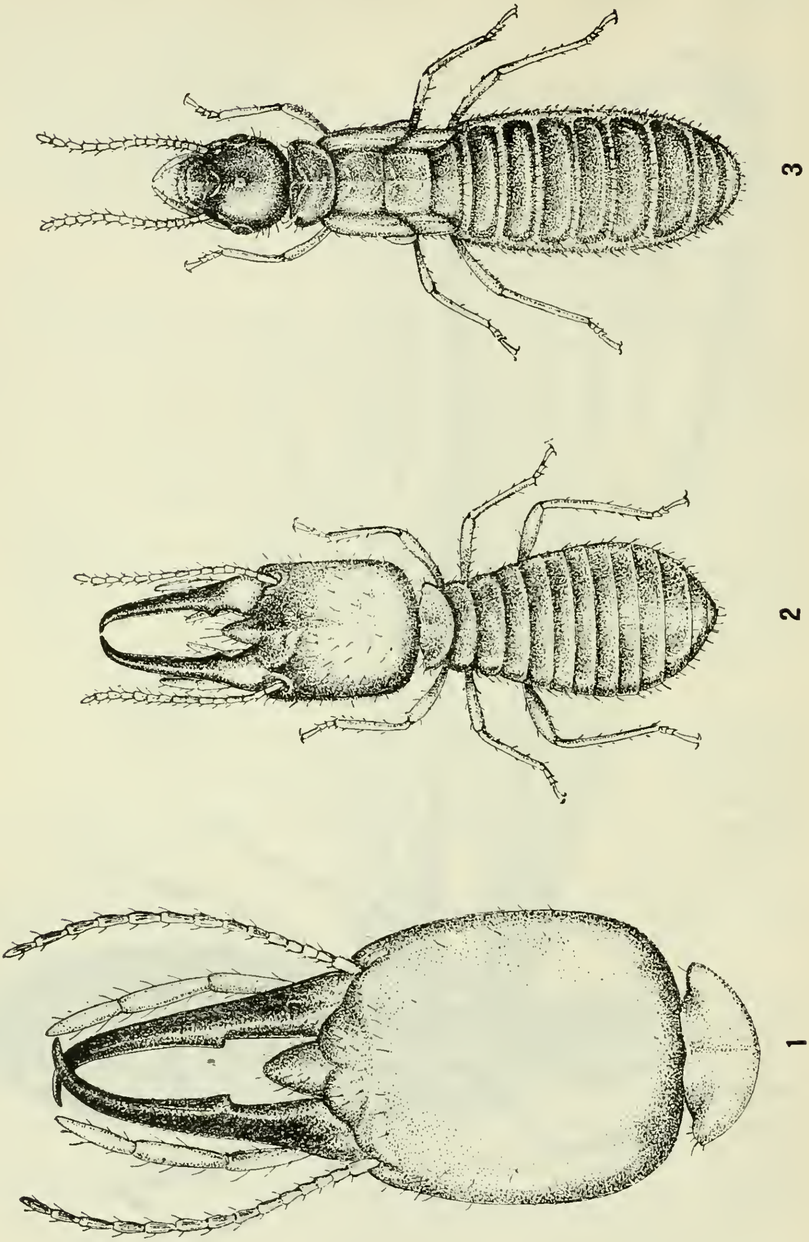

Fig. 42.—Amitermes tubiformans. Dorsal view of head and prothorax of soldier. [Note position of the marginal teeth on mandibles.) × 35. 2. Amitermes arizonensis. Dorsal view of body of soldier. (Note position of the marginal teeth on mandibles.) × 22. 3. Amitermes tubiformans. Dorsal view of young queen of the second form. × 16.

Winged adults from Fort Grant and Oracle, Arizona, flying July 5 to 9 (Hubbard and Schwarz), Sabino Basin, Santa Catalina Mountains, July 8 to 20 (Lutz and Rehn); Tucson, Arizona, May 17.

Soldier.—Pale yellowish; apical part of the abdomen gray; mandibles from tooth outward dark red brown; antennae brownish beyond middle; legs white. Head a little longer than broad, as broad in front as behind; sides slightl rounded; mandibles as long as head, hardly curved except near tips; a distinct tooth on each rather more than one-third way out; antennae a little longer than the mandibles; first joint long; second one-half of first; third about as long as second; others gradually a little longer; labrum narrow, almost pointed at tip; gula with straight sides, gradually narrowing a little from behind forward. Body and legs densely clothed with fine whitish hair.

Length of head plus mandibles, 2.7 mm. (Figs. 42, 2; 44.)

From Nogales, Santa Cruz County; Tucson and Catalina Mountains (Fenner and Sabino Canyons), Pima County (Snyder and Hofer), Ray Junction (H. S. Barber), and Oracle (W. M. Wheeler), Pinal County, Arizona; and workers only, which probably belong to this species, from Arrowhead Springs, San Bernardino County, California (Snyder); workers and soldiers from Palm Springs (Riverside County), California (Hubbard). (Fig. 43.)

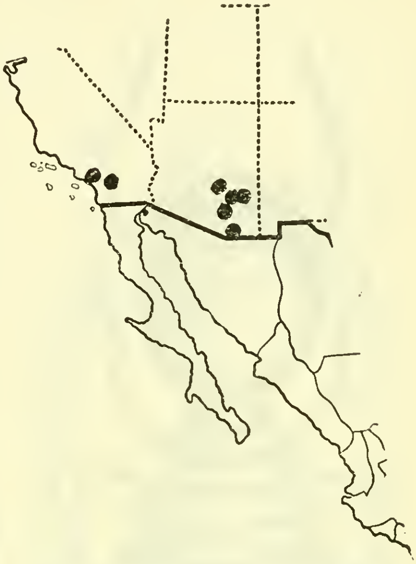

FIG. 43.—DISTRIBUTION OF AMITERMES ARIZONENSIS.

Type, winged adult.—Cat. No. 21867, U.S.N.M.

AMITERMES WHEELERI Desneux.

Soldier.—Pale, yellowish; abdomen gray, legs pale yellowish; mandibles beyond the basal third red-brown; antennae scarcely darkened. Head plainly one-fourth longer than broad, about as broad in front as behind; sides nearly straight and parallel; labrum with rounded tip. Mandibles about as long as width of head, slender, curved (more slender than in *A. californicus*); near the end of basal third is a distinct rather sharp-pointed tooth; antennae about one and a half times longer than the mandibles; the basal joint rather long; second, third, and fourth very short. Gula plainly broader behind than in front. Body and legs with fine white hairs.

Length of head plus mandibles, 2 mm. (Fig. 45, 1.)

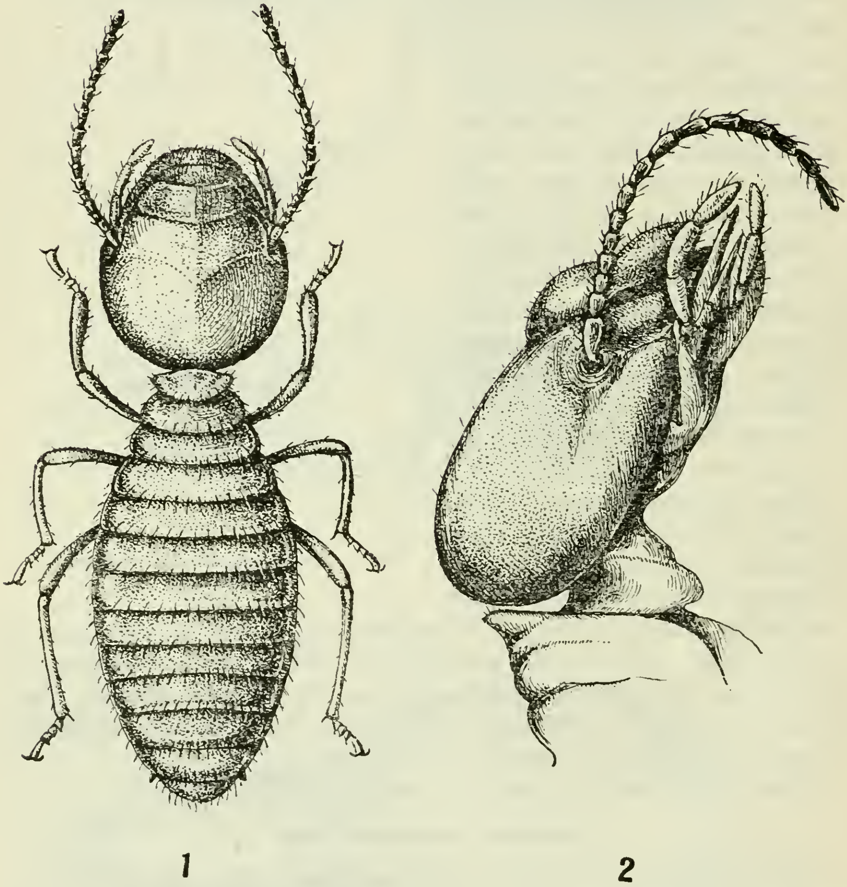

FIG. 44.—1. AMITERMES ARIZONENSIS. DORSAL VIEW OF WORKER. × 20. 2. AMITERMES ARIZONENSIS. LATERAL VIEW OF HEAD AND PROTHORAX OF WORKER. × 60.

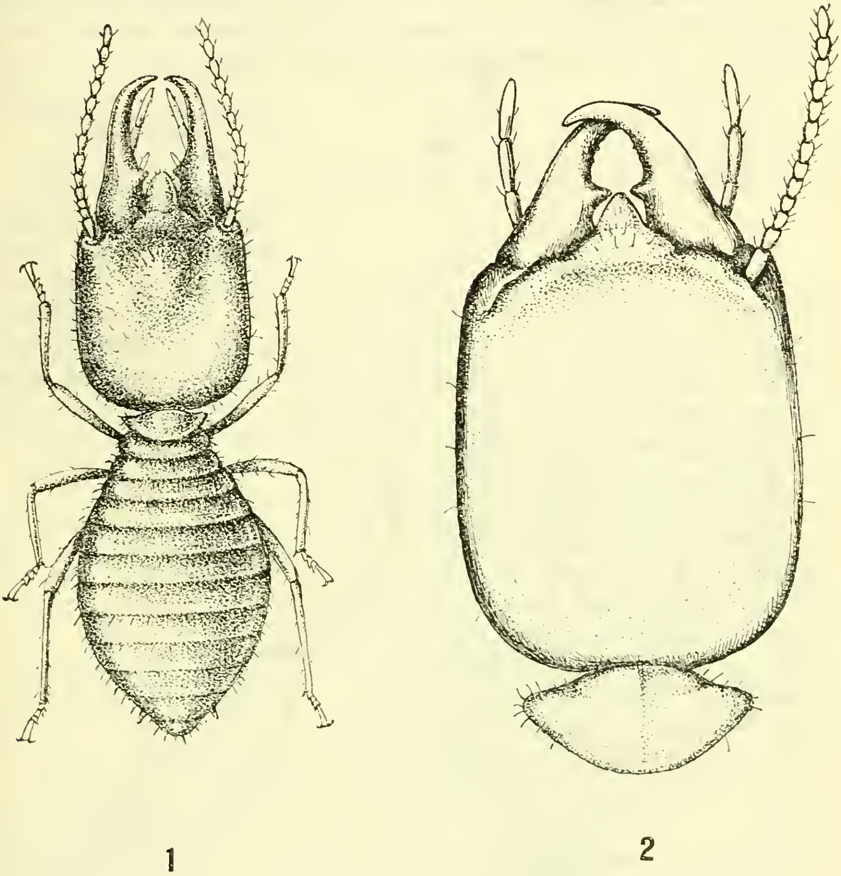

FIG. 45.—1. AMITERMES WHEELERI. DORSAL VIEW OF BODY OF SOLDIER. × 24. 2. AMITERMES CALIFORNICUS. DORSAL VIEW OF HEAD AND PROTHORAX OF SOLDIER. × 62.

Winged form unknown.

Occurs in many places in Texas. Collected by Snyder as follows: Brownsville, Cameron County; Cotulla, Lasalle County; San Antonio; Bexar County; Uvalde, Chalk Bluff, and Laguna, Uvalde County, and El Paso, El Paso County. (Fig. 46.)

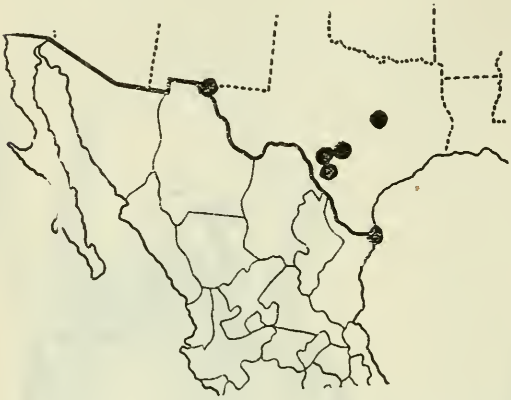

Fig. 46.—Distribution of Amitermes wheeleri.

Cotypes are in the American Museum Natural History (compared).

AMITERMES CALIFORNICUS.
new species.

Soldier.—Yellowish; abdomen, gray; legs, whitish; mandibles, from basal third out, red-brown; antennae, pale; 13 segments.

Head a little longer than broad, as broad in front as behind; sides hardly rounded; labrum with rounded tip. Mandibles short and heavy, not as long as widt of the head, strongly curved; a stout, blunt tooth on each a little beyond basal third. Antennae about twice as long as mandibles, basal joint long, second one-half as long, third equal second, fourth and others gradually longer and larger. Gula broader behind, tapering forward. Body and legs with rather long, fine, white hair.

Length of head plus mandibles, 2.1 mm. (Fig. 45, 2.)

From Jacumba, San Diego County, California (Keen), along the boundry line of Lower California and Arrowhead Springs, San Bernardino County, California (Snyder). In Arizona, Sabino Canyon, Santa Catalina Mountains (Hofer). (Fig. 47.)

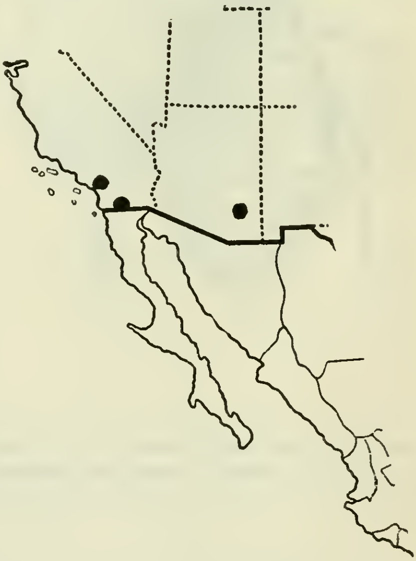

Fig. 47.—Distribution of amitermes californicus.

Type, soldier.—Cat. No. 21870, U.S.N.M.

Winged.—The adult of this species is closely related to *A. arizonensis;* the head, pronotum, and wings are all closely similar to that species, except that on the head the fontanelle is much larger, broader, and situated higher up, being nearly as close to the vertex as to the front margin of the head; the ocelli are a little nearer to the eyes than in *arizonensis;* the mandibles are perhaps larger, or at least proportionally so; the apex with two long, nearly subequal teeth. The antennae are 15-jointed, slightly clavate, the last few joints very much longer than those toward the base. The eyes are less than their diameter from the lower margin of the head. In color they are paler than the other species, the head above being brown, the rest of the body and legs yellowish; the wings are gray, about as in *arizonensis.*

Length, 8 to 8.5 mm.

From Sabino Canyon, Arizona, June 20, 1918, at light (Hofer). Although not taken with soldiers, it is practically certain that they belong to this species.

AMITERMES (?) PERPLEXUS, new species.

Winged.—Head dark brown, clypeus brown, mouth parts pale, tips of mandibles black; pronotum, thorax, and hard parts of abdomen brown, venter and legs yellowish. Wings uniform grayish-the venation dark, especially the radial sector. Head high, swollen above, much higher above the eyes than in *C. tenuirostris;* eyes round, less than diameter from the lower margin of head, more than twice diameter from hind margin; ocelli large, oblique, about their short diameter from eyes; fontanelle distinct, circular, placed

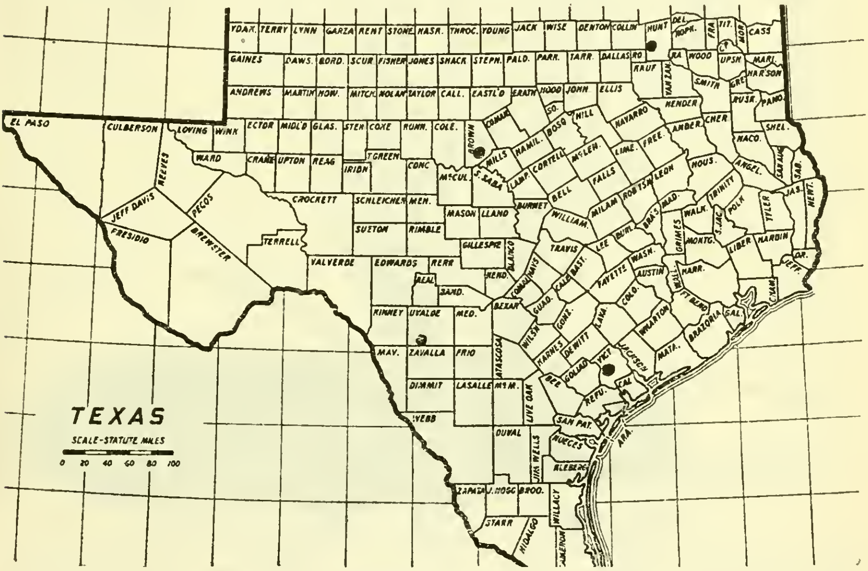
TEXAS
SCALE-STATUTE MILES
0 20 40 60 80 100
YOAK.
TERRY
LYNN
GARZA
KENT
STONE
HASK.
THROC.
YOUNG
JACK
WISE
DENTON
COLLIN
HUNT
DEL.
HOPK.
FRA
TIT.
MOR
CASS
C.P.
GAINES
DAWS.
BORD.
SCUR
FISHER
JONES
SHACK
STEPH.
PALO.
PARK.
TARR.
DALLAS
RO
RA
WOOD
UPSH
MARI.
KAUF
VAN ZAN
SMITH
GREG
HARRISON
ANDREWS
MARTIN
HOW.
MITCH
NOLAN
TAYLOR
CALL.
EASTL'D
ERATH
HOOD
JOHN
ELLIS
HENDER
RUSK
PANO.
SO.
HILL
NAVARRO
ANDER.
CHER
SHEL.
NACO.
EL PASO
CULBERSON
LOVING
WINK
ECTOR
MIDL'D
GLAS.
STER
COKE
RUNN.
COLE.
BROWN
COMAN
BOSQ
HAMIL.
MILLS
WARD
CRANE
UPTON
REAG
IRION
T.GREEN
CONC
McCUL
S.SABA
LAMP.
CORYELL
McLEN.
LIME.
FREE.
HOUS.
ANGEL.
SAN AUG
SAB.
REEVES
JEFF DAVIS
PECOS
CROCKETT
SCHLEICHER
MEN.
MASON
LLANO
BURNET
BELL
FALLS
MILAM
ROBTSN
LEON
MAD.
TRINITY
POLK
TYLER
JAS.
NEWT.
PRESIDIO
BREWSTER
TERRELL
SUTTON
KIMBLE
GILLESPIE
BLANCO
WILLIAM.
BRAS.
WALK.
S.JAC
GRIMES
MONTG.
LIBER
HARDIN
TRAVIS
LEE
BURL
WASH.
VALVERDE
EDWARDS
KERR
KEND.
COMAL
HAYS
BAST.
FAYETTE
AUSTIN
WALL.
HARR.
JEFF.
OR.
REAL
BAND.
KINNEY
UVALDE
MED.
BEXAR
GUAD.
CALD.
GONZ.
COLO.
FT BEND
CHAM.
GAL.
WHARTON
BRAZORIA
MAY.
ZAVALLA
FRIO
ATASCOSA
WILSN
KARNES
DEWITT
LAVA
JACKSON
MATA.
VICT
DIMMIT
LASALLE
MCM.
LIVE OAK
BEE
GOLIAD
REFU.
CAL
WEBB
SAN PAT.
ARA.
DUVAL
JIM WELLS
NUECES
KLEBERG
ZAPATA
J.HOGG
BROO.
WILLACY
STARR
HIDALGO
CAMERON

FIG. 48.—DISTRIBUTION OF AMITERMES (?) PERPLEXUS.

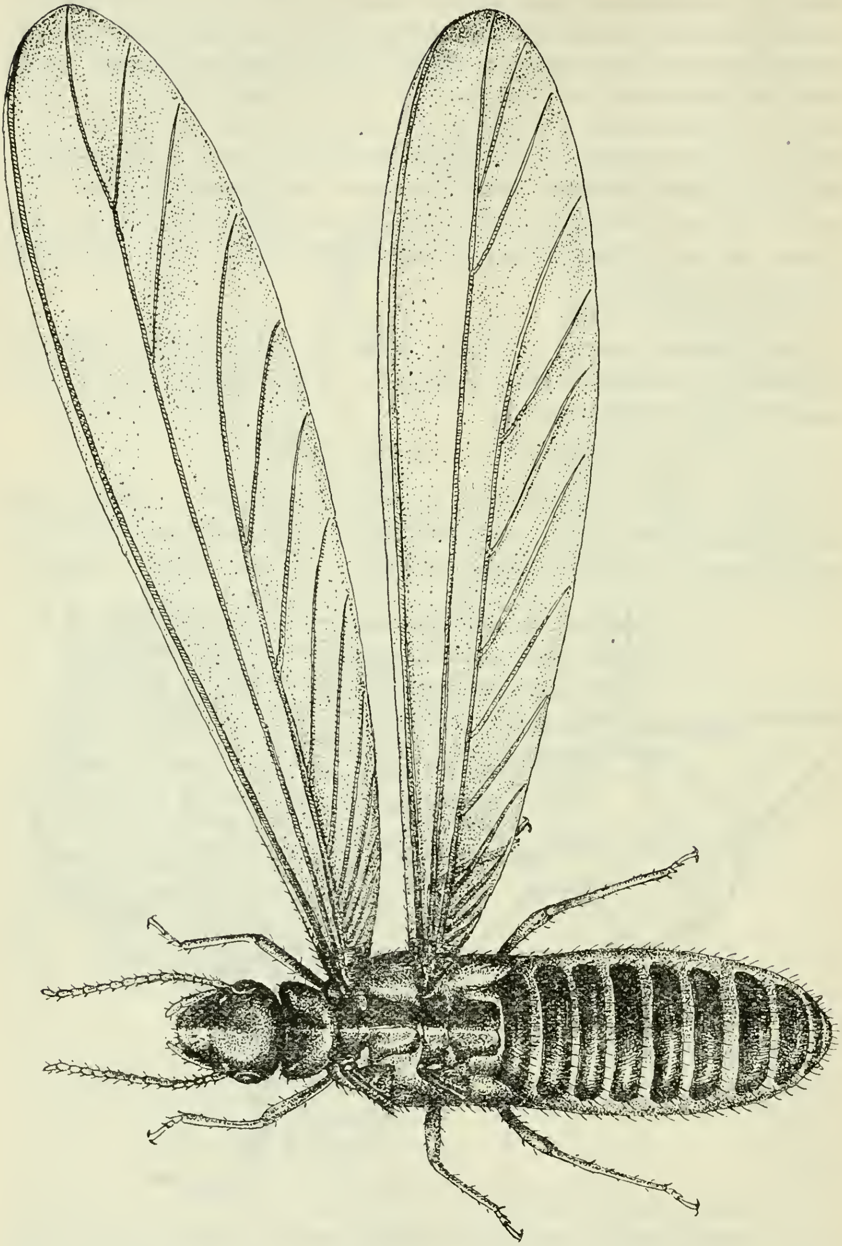

FIG. 49.—AMITERMES (?) PERPLEXUS. DORSAL VIEW SEXUAL, WINGED ADULT, WINGS EXTENDED SHOW VENATION. × 16.

about on line connecting tops of eyes; antennae about as long as width of head, 14 to 15-jointed, second and third joints very short. Pronotum hardly twice as broad as long, nearly straight across in front; posterior sides rounded into the hind margin. Wing scale much shorter than the pronotum. Wings about twice the length of the entire body; cubitus with 8 to 10 branches; median vein runs closer to cubitus than to radial sector, with several branches; the first in forewings usually beyond middle, in hind wings at or before middle. Head with black hair, pronotum and rest of body with yellow hair.

Length to tip of wings, 13 mm. (Fig. 49.)

From Texas, Victoria, July 8 (Mitchell), Clinton, June (Tucker); Langtry, June 3. (Fig. 48.)

Type, winged adult.—Cat. No. 21868, U.S.N.M.

AMITERMES (?) CONFUSUS, new species.

Winged.—Close to *A. perplexus* and of the same general structure; the head, however, is hardly as high above the eyes; the large ocelli are their short diameter from the eyes; the fontanelle is on a line connecting the tops of the eyes; the clypeus is pale yellowish, and the pronotum is not so much narrowed behind as in that species; the color of the hair and wings is the same. It is a rather larger species. The antennae 15-jointed, dark beyond middle.

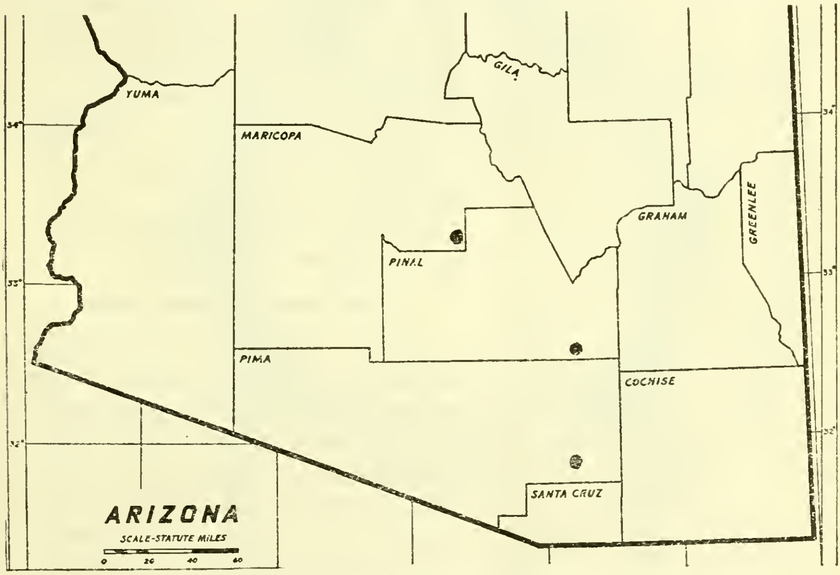

Fig. 50.—Distribution of amitermes (?) confusus.

Length to tip of wings, 14 to 15 mm.

From Arizona, Fort Grant (Hubbard), Oracle (Hubbard and Schwarz), Florence (Biederman), Santa Rita Mountains (Snow), Higley (Wheeler), Black Dike Prospect Serritas (Lutz and Rehn), Serritas, July 26 to 29 (Lutz and Rehn); and Texas, Fort Davis, Jeff Davis County (Wheeler); flying in June and July. (Fig. 50.)

This is quite possibly the *Termes nigriceps* from western Mexico, but as the type is lost and the description would fit at least two other of our species, and doubtless there are more allied species in Mexico, it is better to drop that name for the present. It is described by Holmgren under *E. nigriceps*, but his nasuti are another form.

Type, winged adult.—Cat. No. 21869, U.S.N.M.

Genus ANOPLOTERMES Fritz Müller.

Winged.—Head broader than long; clypeus long, hardly twice as broad as long; ocelli distinct; no apparent fontanelle or very minute; mandibles elongate, about once and a half longer than in allied genera; gula small, broader than long; antennae of about 15 joints, joints 2, 3, and 4, all very short; front wing scale small; wings moderately long, margin ciliated, membrane not noticeably hairy; median vein runs close to the cubitus, with several branches before tip, cubitus ending some distance before tip. (Pl. 4, fig. 2.) Legs short, hind pair scarcely reaching tip of abdomen; tibia with two apical spines. Body and legs densely hairy.

Soldier.—No soldier has been found, and doubtless does not exist

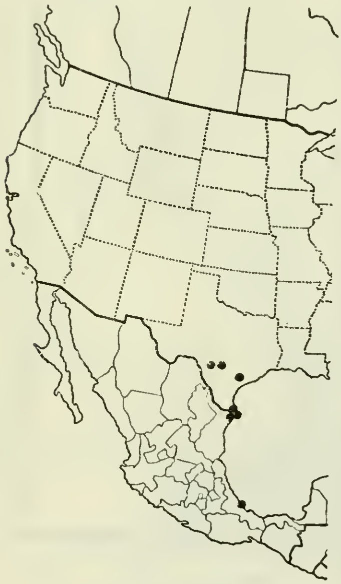

FIG. 51.—DISTRIBUTION OF ANOPLOTERMES FUMOSUS.

ANOPLOTERMES FUMOSUS Hagen.

Winged.—Head dark brown, clypeus dark, mouth parts paler; pronotum and segments of abdomen brown; legs yellowish. Head short, broader from eye to eye than long from clypeus to occiput; clypeus very large; labrum long, rounded at tip; mandibles elongate, projecting below head; eyes round, less than one-third diameter from lower margin of head; ocelli oblique, fully their long diameter from eye; fontanelle not visible. Antennae fully as long as head, more than 14-jointed; third and fourth joints very short. Pronotum narrower than head, about twice as broad as long, slightly, angularly indented in front; sides rounded into the convex hind margin; wing scale not more than length of pronotum. Wings about twice as long as the entire body, dark, veins darker, median forks shortly beyond middle of wings; the

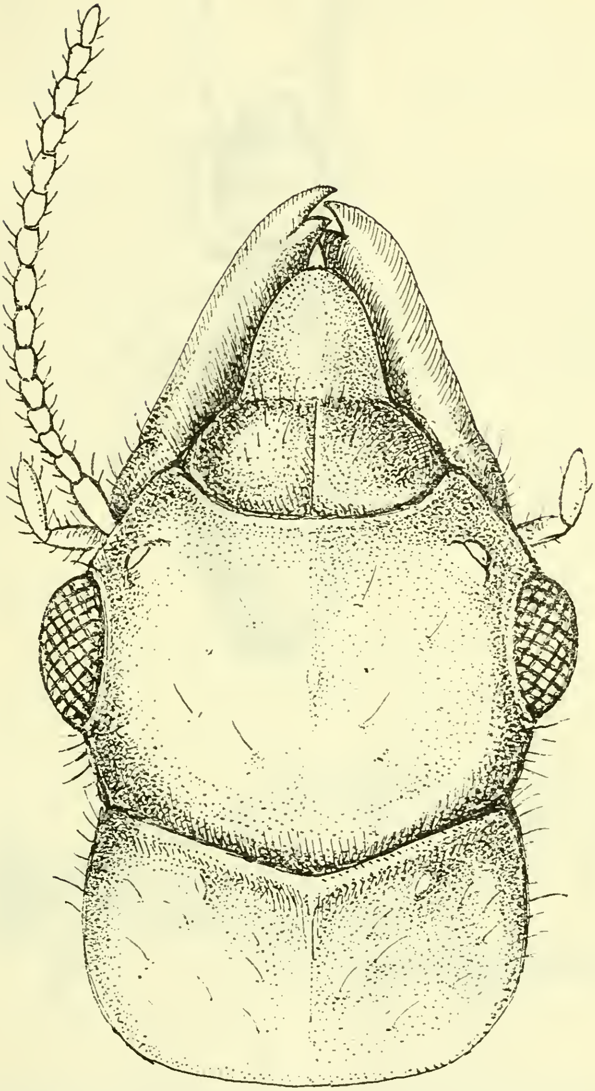

FIG. 52.—ANOPLOTERMES FUMOSUS. VIEW OF HEAD OF SEXUAL, WINGED ADULT. (NOTE LENGTH OF MANDIBLES, PROMINENT EYES, AND OCELLI.) ×60.

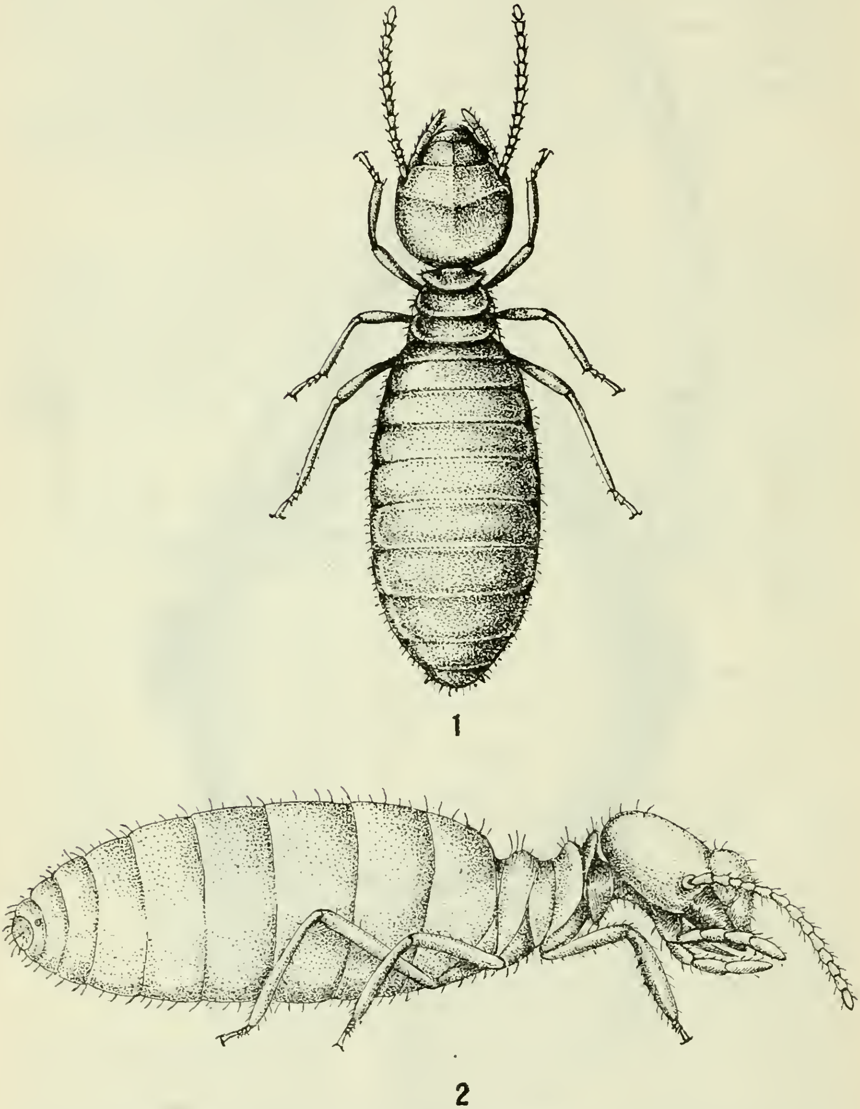

Fig. 53.—1. Anoplotermes fumosus. Dorsal view of worker. × 24. 2. Anoplotermes fumosus. Lateral view of worker. (Note fusiform shape of body and saddle-shaped prothorax.) × 30.

cubitus ends long before tip, six or seven branched. Body densely hairy; that on head dark, on pronotum grayish, on abdomen plainly yellowish to golden.

Length to tip of wings, 7.5 mm. (Figs. 52 and 53.)

From Matamoras, Mexico, and Harlingen, Texas, 1st August (winged) (Mitchell); workers collected by Snyder from Texas as follows: Brownsville, Cameron County; Victoria, Victoria County; San Antonio, Bexar County; and Uvalde, Uvalde County. (Fig. 51.)

NASUTITERMES, new genus.

I use this for the *Eutermes* s. s. of Holmgren, with *Eutermes morio* Latreille as type. Clypeus several times as broad as long, very plainly bilobed, fontanelle small, elongate, forking below, and some muscular impressions below it more or less distinct, ocelli rather small, hardly elongate; antennae short, with the third joint not noticeably longer than the second or fourth; tibia of front legs with two apical spurs; none on outer side; the hairs below tibia fine, not spine-like. Mandibles moderately short.

Soldier.—Head nasute, mandibles small; no constriction to head; antennae with third joint a little longer than second. This generic name was used by Dudley in 1890, but without mentioning any specific name. I can not find that it will agree with any of the numerous subdivisions of *Eutermes* except with *Eutermes* in the restricted sense of Holmgren.

NASUTITERMES COSTARICENSIS Holmgren.

Adult.—Head and other parts reddish brown; mouth parts, antennae, legs, and venter yellowish; all clothed with fine, yellowish hair. Head broader than long; eyes small, nearly circular; ocelli about circular, scarcely long diameter from the eyes; antennae short; second, third, and fourth joints short, subequal; others beyond scarcely longer, but broader; pronotum about one and two-thirds times as broad as long; front margin hardly concave, but little elevated in middle; sides rounded behind into the hind margin. Wings absent.

Length of body, 7 mm.

Closely similar to *N. morio,* but not as dark colored, and the ocelli are nearer to the eyes; it is apparently the same as *N. sanchezi* of the West Indies, but for the present will keep it separate.

Soldier.—Head dark brown; thorax and abdomen above brownish yellow; legs pale yellowish. Head pyriform, not constricted; the projection rather long and slender; from the side the head has a nearly straight outline in front; above are several long erect hairs and about four in a transverse row just above base of the beak; antennae 13-jointed, third joint a little longer than the second or fourth; body and legs with fine, erect, white hairs. (Fig. 54, 1.)

Length of head, 1.5 mm.

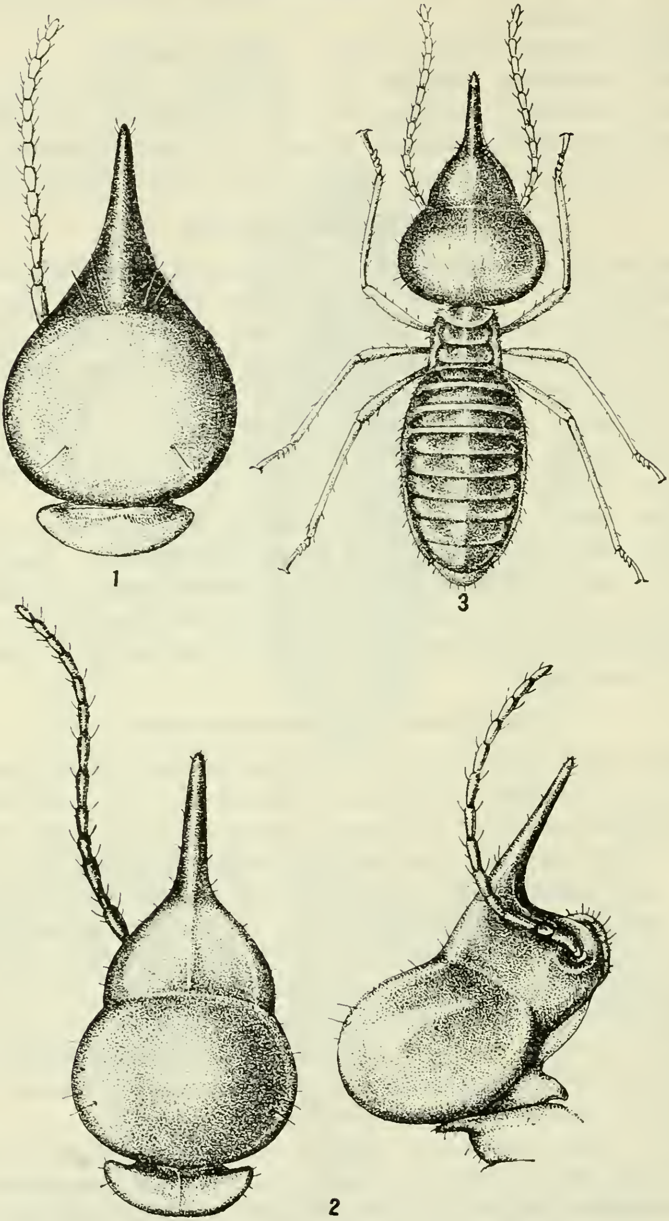

Fig. 54.—1. Nasutitermes costaricensis. Dorsal view of head and prothorax of nasutus. × 50 2. Constrictotermes tenuirostris. Dorsal and lateral views of nasutus. × 30. 3. Dorsal view of body of nasutus. × 30.

Worker.—Head dark brown; right jaw with three teeth; third joint of antennae not longer than others near by.

Two specimens from Texas without more definite indication of locality; a deälated female and two nasuti.

Genus CONSTRICTOTERMES Holmgren.

Winged.—Head broader than long, ocelli present, fontanelle indistinct, situate about as low as the ocelli; clypeus large, bilobed; gula broader than long; palpi short; antennae with about 15 joints, third joint plainly longer than either the second or fourth. Front wing scales moderately large; wings very long, more or less twisted near tips; margins ciliated, membrane sparsely hairy, median vein runs much closer to the cubitus than to radial sector, usually with traces of superior branches; cubitus and its branches strong and distinct, ending near tip of wing; behind the radial sector near tip is some evidence of reticulation. Legs reach tip of abdomen or beyond; tibia with two apical spines; body and legs densely hairy.

Soldier.—Similar to that of *Nasutitermes*, but the head is constricted across the lower front and the legs are very slender and long.

KEY TO SPECIES.

Winged.

1. Ocelli fully short diameter from eyes.......................................*cinereus*.
   Ocelli closer to eyes...*tenuirostris*.

Soldier.

1. Antennae 12-jointed; head blacker; size smaller..........................*cinereus*.
   Antennae 13-jointed; head more reddish; size larger.....................*tenuirostris*.

CONSTRICTOTERMES TENUIROSTRIS Desneux.

Winged.—Pale brownish yellow, front and segments of abdomen rather more brown; densely clothed with golden or yellowish hair, that on the front mostly brown and that on venter more gray or white. Head broader than long, eyes large, nearly circular, not one-third diameter from the lower margin, not much more than their long diameter from the hind margin; clypeus about two and a half times as broad as long; as long as distance of ocelli to clypeus; ocelli large, hardly one-half diameter from the eyes; fontanelle faint, about as low as ocelli; antennae longer than head, 15-jointed, third joint plainly longer than fourth. Pronotum nearly twice as broad as long, broadest in front; front margin nearly straight across, sides sloping backward and rounded into the hind margin; fore wing scale not nearly as long as the pronotum. Wings about three times as long as the abdomen, often more or less twisted toward tip, dull grayish; costal veins yellowish; other veins more brown, distinct; membrane with minute, sparse, golden hair; cubitus with 10 or more branches; median vein forked toward tip, often with traces of superior branches.

Length to tip of wings, 20 mm. (Fig. 55.)

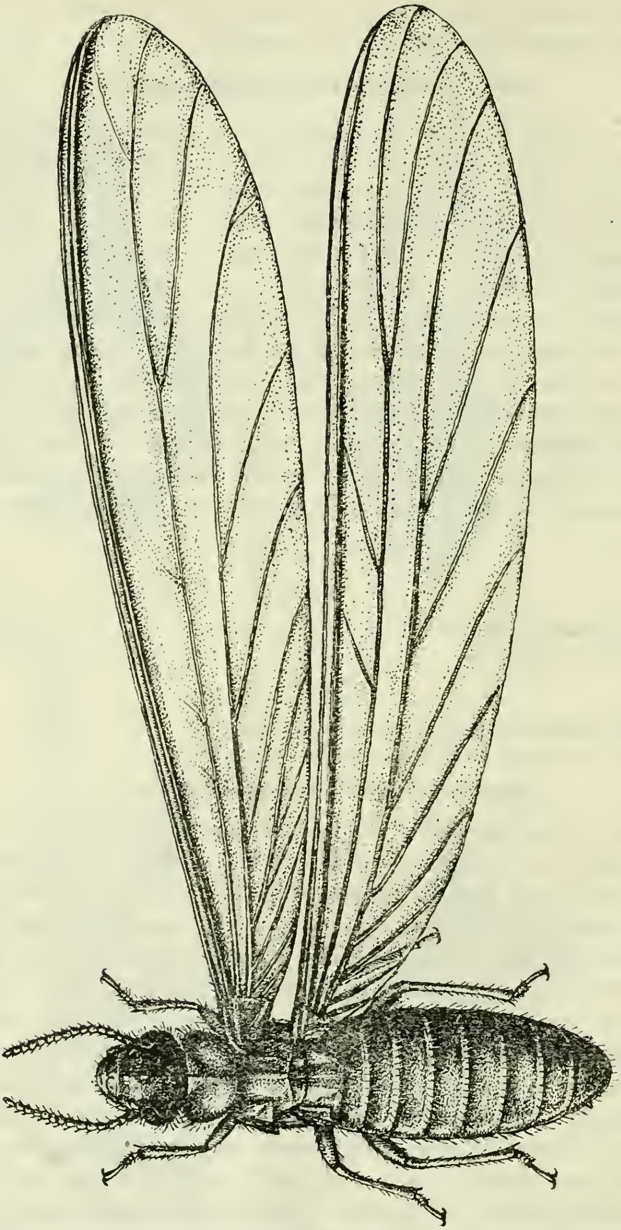

FIG. 55.—CONSTRICTOTERMES TENUIROSTRIS. DORSAL VIEW OF SEXUAL, WINGED ADULT WITH WINGS EXTENDED TO SHOW VENATION. × 10.

Soldier.—Nasute. Head reddish brown; beak mostly black, but extreme tip reddish; thorax and abdomen brown above; antennae and femora paler brown; rest of legs yellowish. Head constricted as in figure, from side, divided into three subequal parts; the globose upper part, the free beak, and the lower part of head, which from the side is but slightly convex, and hardly as long as the free beak, all with some erect hairs, those on globose part as long as vertical thickness of beak at middle; antennae 13-jointed; first and third subequal, much longer than the others; second very short; thorax and abdomen with long hairs; legs with short hair. (Figs. 54, 2 and 3; 57.)

Length of head, 1.5 mm. to 1.6 mm.

Occurs in Arizona and Texas. In Arizona, from Nogales (Santa Cruz County), on the Mexican border (Oslar); in the Huachuca Mountains (Kunze) and Palmerlee and Garcia (Biederman), in Cochise County; in the Santa Rita Mountains, elevation 5,000 to 8,000 feet (Snow); in the Santa Catalina Mountains (Schwarz), Sabino Basin, Santa Catalina Mountains, in Pima County, July 8 to 20 (Lutz and Rehn) also Catalina Springs; and Oracle (Pinal County) (Wheeler), and in the Pinaleno Mountains, Post Canyon elevation 5,000 to 6,000 feet, Graham County (Wheeler). In Texas from Fort Davis, Jeff Davis County (Wheeler). (Fig. 56.)

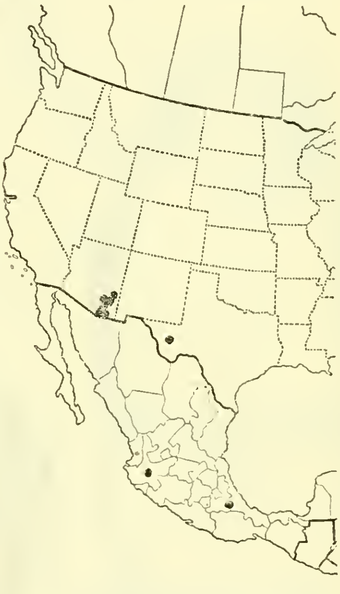

FIG. 56.—DISTRIBUTION OF CONSTRICTOTERMES TENUIROSTRIS.

CONSTRICTOTERMES CINEREUS Buckley.

Winged.—Very similar to *C. tenuirostris;* of the same size and color, pubescence, and general structure. It differs in having the ocelli fully one-half their long diameter (about their short diameter) from the eyes. The pronotum is a trifle longer and more narrowed behind, and the sides evenly rounded into the rounded hind margin. The wings are paler in color than in *C. tenuirostris.* (Fig. 58, 1.)

C. strenuus Hagen from Vera Cruz, Mexico, is a very similar species, but the ocelli are very much smaller and still farther from the eyes.

Soldier.—Nasute. Closely resembles *C. tenuirostris,* except smaller throughout. The head is more black on globose part and there is more reddish showing at tip of beak; the hairs on head in front are proportionally fewer, but proportionally a little longer. The antennae are but 12-jointed; the first and third long and second very short, as in *C. tenuirostris.*

Length of head, 1.3 to 1.4 mm.

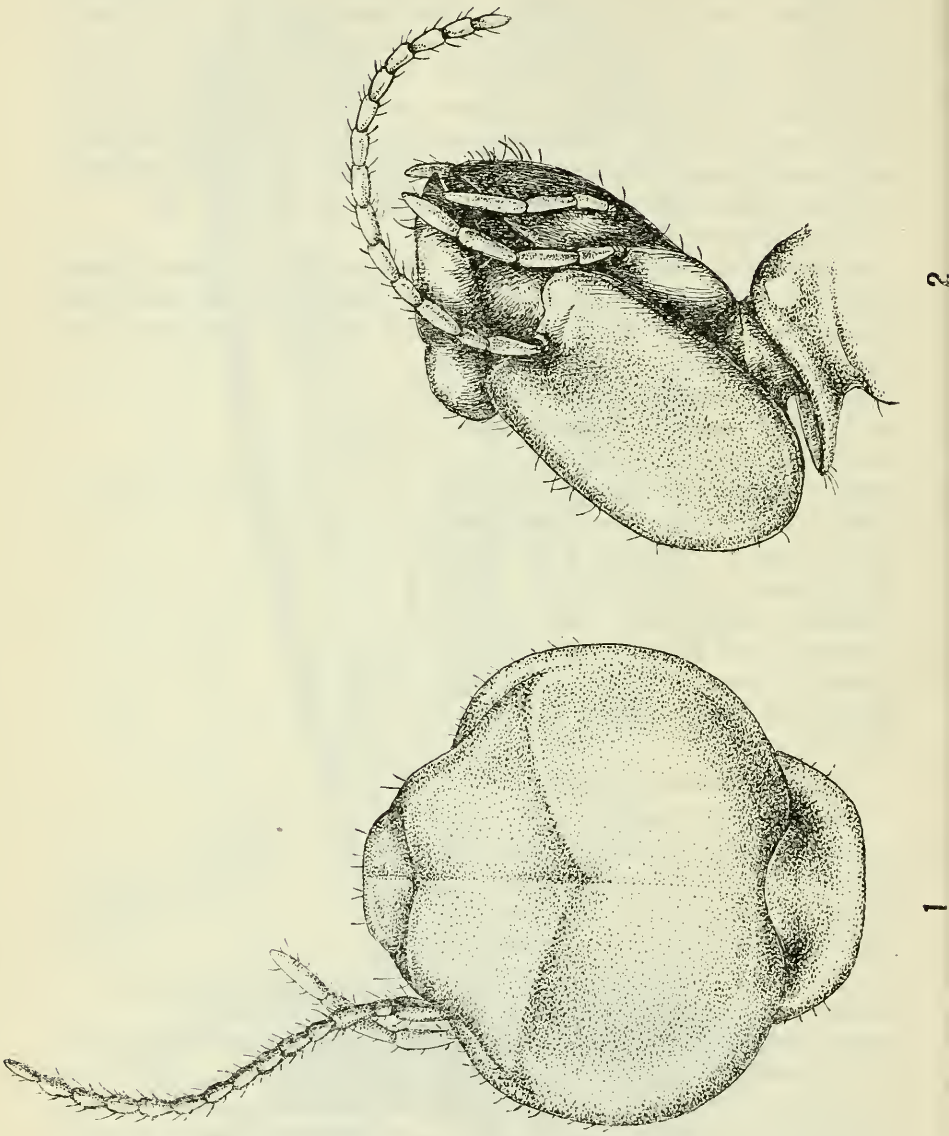

FIG. 57.—1. CONSTRICTOTERMES TENUIROSTRIS. DORSAL VIEW OF HEAD AND PROTHORAX OF WORKER. × 60. 2. LATERAL VIEW OF HEAD AND PROTHORAX OF WORKER. (NOTE SADDLE-SHAPED PROTHORAX.) × 27.

Workers about the same as *C. tenuirostris,* but in *tenuirostris* the head is more reddish and *cinereus* is more brown; both 14-jointed antennae.

Occurs in Texas, from San Diego, Duval County, Beeville, Bee County (Schwarz); New Braunfels (Comal County) (Wheeler); Uvalde September 21 (Parman) and Uvalde and Laguna, Uvalde County (Snyder); Tiger Mills, Burnet County (Schaupp); Lampasas, Lampasas County (Cushman); and west to Devils River, Valverde County (Webster). (Fig. 59.)

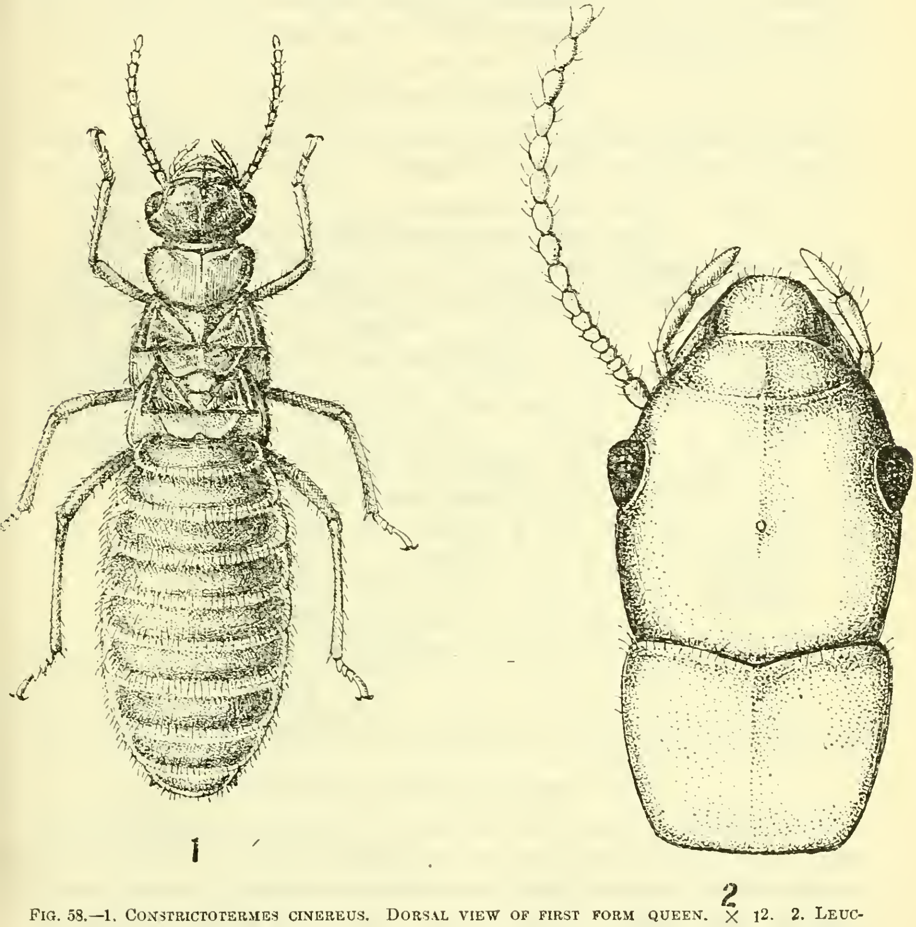

Fig. 58.—1. Constrictotermes cinereus. Dorsal view of first form queen. × 12. 2. Leucermes tenuis. Dorsal view of head and prothorax of sexual, winged adult. (Note absencoe of ocelli.) × 46.

Genus LEUCOTERMES Silvestri.

Winged.—Clypeus three times as broad as long, not near as long as in most *Eutermes*; no ocelli; fontanelle indistinct; antennae with joints 2, 3, and 4 very short; gula as broad as long, rather broader behind than in front. Front wing scales much larger than hind ones; wings moderately long, not reticulate, opaque, margins ciliated; the median runs close to the cubitus, and there are traces of oblique superior branches. Legs short, reaching but little beyond tip of body, tibia with two apical spines.

Soldier.—Head rather long, with parallel sides, long untoothed slightly curved, mandibles; labrum not very elongate and hardly pointed at tip. The pronotum broader in front than behind, and the front margin deeply indented in the middle; the gula is broader in front than behind.

LEUCOTERMES TENUIS Hagen.

Winged.—Pale yellowish throughout, eyes hardly circular, almost diameter from lower margin of head; antennae much longer than head, 17-jointed. Pronotum much narrower than the head, about one and two-third times as broad as long, emarginate in middle of front margin, sides sloping a little backward and rounded into the nearly straight hind margin. (Fig. 58, 2.) Fore wing scale plainly longer than the pronotum, body rather densely clothed with short, very fine white hairs. Wings pale dull yellowish, costal veins more yellow; in length nearly twice the body, median vein runs nearer to cubitus than to radial sector and extends to tip of the wing; near apical fourth it often forks; the cubitus ends near tip of the wing; it has 7 to 9 branches, the apical ones forked. Length to tip of wings, 9 to 10 mm.

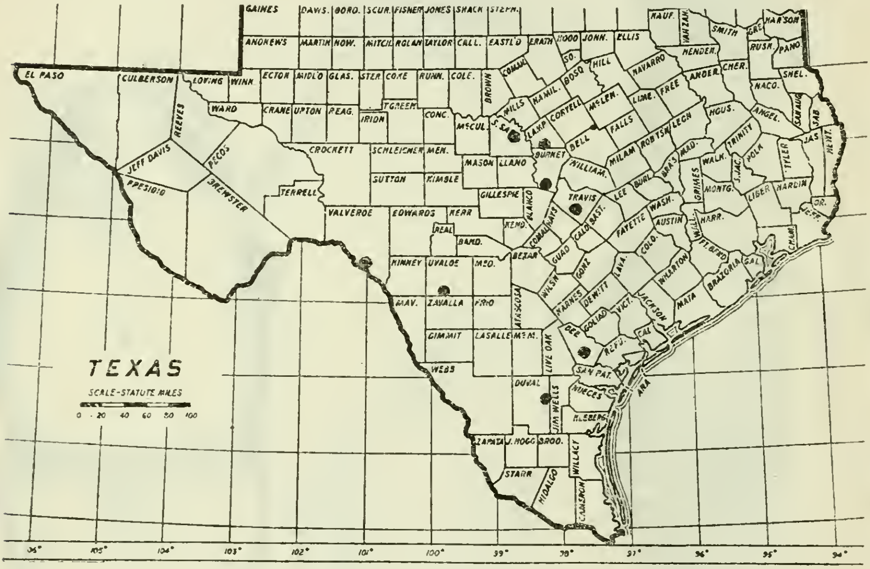
TEXAS
SCALE-STATUTE MILES
0
20
40
60
80
100
EL PASO
CULBERSON
LOVING
WINK
WARD
REEVES
JEFF DAVIS
PRESIDIO
PECOS
BREWSTER
TERRELL
GAINES
ANDREWS
ECTOR
CRANE
DAWS.
MARTIN
MIDL'D
UPTON
BORO.
HOW.
GLAS.
REAG.
SCUR.
MITCH.
STER
IRION
FISHER
NOLAN
COKE
TGREEN
JONES
TAYLOR
RUNN.
CONC.
SHACK
CALL.
COLE.
STEPH.
EASTL'D
BROWN
MCCUL.
CROCKETT
SCHLEICHER
MEN.
SUTTON
KIMBLE
MASON
LLANO
GILLESPIE
VALVERDE
EDWARDS
KERR
REAL
BAND.
KENDALL
KINNEY
UVALDE
MED.
BEXAR
MAV.
ZAVALLA
FRIO
ATASCOSA
DIMMIT
LASALLE
MCM.
LIVE OAK
WEBB
DUVAL
JIM WELLS
NUECES
KLEBERG
ZAPATA
J. HOGG
BROO.
WILLACY
STARR
HIDALGO
CAMERON
ERATH
HOOD
JOHN.
ELLIS
COMAN.
SO.
HILL
MILLS
HAMIL.
BOSQ.
S. SABA
LAMP.
CORYELL
MCLEN.
NAVARRO
LIME.
FREE
BELL
FALLS
BURNET
WILLIAM.
MILAM
ROBTSN.
LEON
TRAVIS
LEE
BURL.
BRAZ.
MAD.
BLANCO
HAYS
CALD.
BAST.
FAYETTE
WASH.
COMAL
GUAD
WILSN.
GONZ.
LAVA.
COLO.
AUSTIN
KARNES
DEWITT
GOLIAD
VICT.
JACKSON
WHARTON
BEE
REFU.
CAL.
SAN PAT.
ARA.
MATA.
BRAZORIA
FT. BEND
WALL.
HARR.
GAL.
CHAM.
GRIMES
MONTG.
WALK.
TRINITY
S. JAC.
POLK
LIBER.
HARDIN
JEFF.
OR.
TYLER
JAS.
NEWT.
SAB.
SHEL.
ANGEL.
NACO.
HOUS.
ANDER.
CHER.
RUSK.
PANO.
HENDER.
SMITH
GRE.
HARRISON
KAUF.
VANZAN.
95°
105°
104°
103°
102°
101°
100°
99°
98°
97°
96°
95°
94°

FIG. 59.—DISTRIBUTION OF CONSTRICTOTERMES CINEREUS.

From Fish Hawk Key, Andros Island, Bahamas, May 19, various places in Cuba and southward, and probably will be found on some of the Florida keys.

CATALOGUE OF NEARCTIC TERMITES WITH SYNONOMY.

Order ISOPTERA Brullé.

Superfamily TERMITOIDEA.

Family KALOTERMITIDAE.

Subfamily Termopsinae.

Genus TERMOPSIS Heer.

Heer, Insektenfauna von Oeningen, vol. 2. p. 23, 1849.

Type *T. insignis* Heer.

TERMOPSIS ANGUSTICOLLIS Hagen.

Hagen, Linnaea Entom., vol. 12, (1857) 1858, p. 75; type locality, "Kalifornien," "St. Francisco;" vol. 14, (1859) 1860, p. 101; Syn. Neur. No. Amer., 1861, p. 3; Bull. U. S. Geol. Surv. Territor., 1875, p. 571.

(TERMES CASTANEUS Walker.)

Walker, Brit. Mus. Catalog. Neuroptera, 1853, p. 506, not Burmeister.

Calif., Oreg., Wash., Brit. Columbia.

TERMOPSIS NEVADENSIS Hagen.

(TERMOPSIS ANGUSTICOLLIS Walker, var. NEVADENSIS Hagen.)

Hagen, Bull. U. S. Geol. Surv. Territor., 1875, p. 571; type locality, Nevada, western border.

Nev., Calif., Oreg., Mont., Wash., Brit. Columbia.

TERMOPSIS LATICEPS Banks.

Banks, Ent. News, vol. 17, No. 9, 1906, p. 337; type localities, Douglas and Florence, Ariz.

Ariz., New Mex.

Subfamily Kalotermitinae.

Genus KALOTERMES Hagen.

Hagen, Berlin Acad. Wiss. Ber., Berlin, 1853, p. 480; Verh. Zool.-bot. Ges. Wien., 1854, p. 222.

Type *Termes berendtii* Pictet.

(Genus PTEROTERMES Holmgren.)

Holmgren, Kgl. Svenska Vetensk. Akad., Handl., vol. 46, No. 6, 1911, p. 46. (Type *T. occidentis* Walker.)

KALOTERMES HUBBARDI Banks.

Supra, p. 28; type locality, Tucson, Ariz.

Ariz., Calif., Lower Calif., N. Mex.

KALOTERMES JOUTELI Banks.

Supra, p. 25; type locality, Adam Key, Fla.

S. Fla., Mex.

KALOTERMES MARGINIPENNIS Latreille.

(TERMES MARGINIPENNE Latreille.)

Latreille, Humboldt Recueil Zool., vol. 2, 1811–32, p. 3, pl. 39, fig. 8; type locality, Mexico.

(TERMES MEXICANUS Walker.)

Walker, Brit. Mus. Catalog. Neuroptera, 1853, p. 528.

(CALOTERMES MARGINIPENNIS Latreille.)

Hagen, Linnaea Entom., vol. 12, (1857) 1858, p. 47; vol. 14, (1859), 1860, p. 100.

S. Ga., N. Fla., Tex., Mex.

KALOTERMES APPROXIMATUS Snyder.

Supra, p. 22; type locality, Ortega, Fla.

No. Fla.

KALOTERMES MINOR Hagen.

Hagen, Linnaea Entom., vol. 12, (1857) 1858, p. 47; vol. 14, (1859), 1860 p. 100 (as variety of *marginipennis*); type locality, California.

Ariz., Calif.

KALOTERMES OCCIDENTIS Walker.

(TERMES OCCIDENTIS Walker.)

Walker, Brit. Mus. Catalog. Neuroptera, 1853, p. 529; type locality, West Coast of America [Lower California].

(TERMOPSIS? OCCIDENTIS Walker.)

Hagen, Linnaea Entom., vol. 12, (1857) 1858, p. 77; Bull. U. S. Geol. Surv. Territor., (1874), 1875, p. 572.

Desneux (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Fam. Termitidae, 1904, p. 14.

(PTEROTERMES OCCIDENTIS Walker.)

Holmgren, Kgl. Svenska Vetensk. Akad. Handl., vol. 46, No. 6, 1911. p. 43.

Ariz., Mex., Lower Calif.

KALOTERMES SCHWARZI Banks.

Supra, p. 22; type locality, Adam Key, Fla.

S. Fla., Cuba.

KALOTERMES SIMPLICICORNIS Banks.

Supra, p. 32; type locality, Laguna, Tex.

Tex.

KALOTERMES TEXANUS Banks.

Supra, p. 29; type locality, Chalk Bluff, Tex.

Tex.

Genus NEOTERMES Holmgren.

Holmgren, Kgl. Svenska Vetensk. Akad. Handl., vol. 46, No. 6, 1911.

Type *Termes castaneus* Burmeister.

NEOTERMES CASTANEUS Burmeister.

(TERMES CASTANEUS Burmeister.)

Burmeister, Handb. Ent., vol. 2, 1839, p. 764; type localities, "Kalifornien (St. Francisco)" [an error] "und Portoriko."

(TERMES ANTICUS Walker.)

Walker, Brit. Mus. Catalog. Neuroptera, 1853, p. 523.

(TERMES GUATIMALAE Walker.)

Walker, Brit. Mus. Catalog. Neuroptera, 1853, p. 528.

(CALOTERMES CASTANEUS Burmeister.)

Hagen, Linnaea Entom., vol. 12, (1857), 1858, p. 38.

S. Fla., Porto Rico.

Genus CRYPTOTERMES Banks.

Banks, Entom. News, vol. 17, No. 9, 1906, p. 336.

Type *C. cavifrons* Banks.

CRYPTOTERMES CAVIFRONS Banks.

Banks, Entom. News, vol. 17, 1906, p. 337; type locality, Kissimmee, Fla.

S. Fla.

CRYPTOTERMES INFUMATUS Banks.

Supra, p. 38; type locality, Cotulla, Tex

Tex.

CRYPTOTERMES BREVIS Walker.

(TERMES BREVIS Walker.)

Walker, Brit. Mus. Catalog. Neuroptera, 1853, p. 424, No. 33.

(CALOTERMES BREVIS Walker.)

Hagen, Linnaea Entom., vol. 12, (1857) 1858, pp. 68–70; 1860. vol. 14 (Nachtrag), p. 101.

(CALOTERMES BREVIS Walker.)

Desneux, (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Termitidae, 1904, p. 23.

CRYPTOTERMES BREVIS Walker.

Holmgren, Kgl. Svenska. Vetensk. Akad. Handl., vol. 46, No. 6, pp. 53 and 55.

Fla., Cuba, Jamaica, Central and South America.

Family TERMITIDAE.

Subfamily RHINOTERMITINAE.

Genus PRORHINOTERMES Silvestri.

Silvestri, Fauna Sudwestl. Australiens, vol. 2, 1909, p. 286.

Type *P. inopinatus* Silvestri.

PRORHINOTERMES SIMPLEX Hagen.
(TERMES SIMPLEX Hagen.)
Hagen, Linn. Entom., vol. 12 (1857), 1858, p. 238; type locality, Cuba.
(RHINOTERMES SIMPLEX Hagen.)
Desneux (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Fam. Termitidae, 1904, p. 28.
(ARRHINOTERMES SIMPLEX Hagen.)
Holmgren, Kgl. Svenska. Vetensk. Akad. Handl., vol. 46, No. 6, 1911, p. 72.
So. Fla., Cuba, Jamaica.

Genus RETICULITERMES Holmgren.

Holmgren, Kgl. Svenska Vetensk. Akad. Handl., vol. 50, No. 2, 1913, p. 60.

Type *Termes flavipes* Kollar.

RETICULITERMES CLARIPENNIS Banks.
Supra, p. 47, type locality, Beaumont, Tex.
Tex., Kan., Ariz., Mex.
RETICULITERMES FLAVIPES Kollar.
(TERMES FLAVIPES Kollar.)
Kollar, Naturgesch. d. schädl. Insekten, 1837, p. 411; type locality, Schoenbrunn, Austria.
(TERMES FLAVIPES Burmeister.)
Burmeister, Hdb., vol. 2, p. 768, No. 14; Zoolog. Hand-atlas, pl. 28, figs. 9–10.
(TERMES FLAVIPES Westwood.)
Westwood, Introduct., vol. 2, p. 14, fig. 58, Nos. 12, 14, and 15.
(TERMES FRONTALE Haldeman.)
Haldeman, Proc. Acad. Nat. Sci., Philadelphia, 1844, vol. 2, p. 55.
(TERMES FLAVIPES Kollar.)
Hagen, Linnaea. Entom., vol. 12 (1857), 1858, p. 182; vol. 14 (1859), 1860, p. 107; Syn. Neur. No. Amer., 1861, p. 3.—Banks, Ent. News, vol. 18, No. 9, 1907, p. 392.
LEUCOTERMES FLAVIPES Kollar.)
Silvestri, Boll. Mus. Torino, vol. 16, No. 389, 1901, p. 3; Redia, vol. 1, 1903, p. 37.
(TERMES FLAVIPES Kollar.)
Desneux (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Family Termitidae, 1904, p. 33 (subgenus *Leucotermes* Silvestri).
(RETICULITERMES FLAVIPES Kollar.)
Holmgren, Kgl. Svenska. Vetensk. Akad. Handl., vol. 46, No. 6, 1910, p. 69; vol. 50, No. 2, 1913, pp. 14–5, 60–1; (subgenus Reticulitermes).
Eastern U. S., Me. to Fla., west to Mo. and Ark. and Mex.
RETICULITERMES HAGENI Banks.
Supra, p. 44; type locality, Falls Church, Va.
Ill., Md., Va., S. C., Fla., Tex.
RETICULITERMES HESPERUS Banks.
Supra, p. 50; type locality, Little Bear Lake, San Bernardino Mountains, Calif.
Calif , Oreg., Nev., Wash.

RETICULITERMES LUCIFUGUS Rossi.

(TERMES LUCIFUGUS Rossi.)

Rossi, Mant. Etr., vol. 1, 1792, p. 107, No. 34; vol. 2, pl. 5, fig. K.; type locality, shores of the Mediterranean Sea.

(TERMES LUCIFUGUM Latreille.)

Latreille, Hist. natur., vol. 13, p. 69, No. 5; Diction. d'Hist. nat., vol. 22, p. 61; Genera Crust. et. Ins., vol. 3, p. 206, No. 1.

(TERMES LUCIFUGUS Rambur.)

Rambur, Neurop., p. 304, No. 6.

(TERMES LUCIFUGUS Blanchard.)

Blanchard, Hist. Ins., p. 47, No. 4.

(TERMES LUCIFUGUS Guérin.)

Guérin, Icon. regn. anim., pl. 63, fig. 3.

(TERMES LUCIFUGUS Bobe Moreau.)

Bobe Moreau, Mémoir, etc., 1843, pl. 1.

(TERMES LUCIFUGUS Joly.)

Joly, Mémoir de Toulouse, 1894, vol. 5, pp. 1 to 37, pls. 1–3.

(TERMES LUCIFUGUS Lespès.)

Lespès, Annal. Sci. Nat., ser. 4, vol. 5, p. 228, pls. 1–3.

(LEUCOTERMES LUCIFUGUS Rossi.)

Silvestri, Boll. Mus. Torino, vol. 16, No. 389, 1901, p. 3; Redia, vol. 1, 1903, p. 37.

(RETICULITERMES LUCIFUGUS Rossi.)

Holmgren Kgl. Svenska. Vetensk. Akad. Handl., vol. 46, No. 6, 1910, p. 69; vol. 50: No. 2, 1913, pp. 14–15, 60–61; (subgenus Reticulitermes).

Mass., (Calif.?)

RETICULITERMES HUMILIS Banks.

Supra, p. 51; type locality, Santa Rita (Mountains.), Ariz.

Ariz.

RETICULITERMES HUMILIS Banks.

VAR. HOFERI Banks.

Supra, p. 53; type locality, Sabino Canyon, Santa Catalina Mountains, Ariz.

Ariz.

RETICULITERMES TIBIALIS Banks.

Supra, p. 47; type locality, Beeville, Tex.

Iowa, Ark., Okla., Nebr., Kans., Tex., Colo., N. Mex., Ariz., Utah, Idaho, Nev., Mont., Calif.

RETICULITERMES TUMICEPS Banks.

Supra, p. 53; type locality, Stratton, Santa Catalina Mountains, Ariz.

Ariz.

RETICULITERMES VIRGINICUS, Banks.

(TERMES VIRGINICUS Banks.)

Banks, Ent. News, vol. 18, No. 9, p. 392, 1907; type localities, Falls Church and Chain Bridge, Va., and Washington, D. C.

(RETICULITERMES VIRGINICUS Banks.)

Holmgren, Kgl. Svenska. Vetensk. Akad. Handl., vol. 46, No. 6, 1910, p. 69; vol. 50, No. 2, 1913, pp. 14–15, 60–61; (subgenus Reticulitermes).

Md., Va., Ky., S. C., Ga., Fla., La.

Subfamily TERMITINAE.

Genus AMITERMES Silvestri.

Silvestri, Boll. Mus. Zool. Anat. Torino, vol. 16, No. 398, 1901.

Type *A. amifer* Silvestri.

AMITERMES ARIZONENSIS Banks.

Supra, p. 56; type locality, Fort Grant, Ariz.

Ariz., Calif.

AMITERMES CALIFORNICUS Banks.

Supra, p. 62; type locality, Yacumba, Calif.

Calif., Ariz.

AMITERMES TUBIFORMANS Buckley.

(TERMES TUBIFORMANS Buckley.)

Buckley, Proc. Ent. Soc. Philad., vol. 1 (1862), 1863, p. 213; type locality Lampasas or San Saba County, Tex.

(AMITERMES TUBIFORMANS Buckley).

Silvestri, Boll. Mus. Torino, vol. 16, No. 389, p. 3.

(AMITERMES TUBIFORMANS Buckley).

Wasmann, Zool. Jahrbuch, Syst. 7, vol. 17, Hft. 1, 1902, p. 123.

(TERMES TUBIFORMANS Buckley).

Desneux (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Fam. Termitidae, 1904, p. 46; Ann. Soc. Ent. Belg., 1905, p. 338.

(HAMITERMES TUBIFORMANS Buckley).

Holmgren, Kgl. Svensk. Vetensk. Akad. Handl., vol. 48, No. 4, 1912, p. 91.

Tex., Ariz., Mex.

AMITERMES WHEELERI Desneux.

(TERMES WHEELERI Desneux).

Desneux, Ann. Soc. Ent. Belg., 1905, p. 340; type locality, Belton, Tex.

Tex.

AMITERMES (?) CONFUSUS Banks.

Supra. p. 65, type locality, Oracle, Ariz.

[EUTERMES NIGRICEPS (Haldeman?).]

Holmgren, Mitth. Naturh. Mus. Hamburg, vol. 27, (1909), 1910, p. 313 (part) (not Haldeman).

Ariz., Tex.

AMITERMES (?) PERPLEXUS Banks.

Supra, p. 63; type locality, Victoria, Tex.

Tex.

Genus LEUCOTERMES Silvestri.

Silvestri, Boll. Mus. Zool. Anat. Torino, vol. 16, No. 389, 1901, p. 3.

Type *Termes tenuis* Hagen.

LEUCOTERMES TENUIS Hagen.

(TERMES TENUIS Hagen).

Hagen, Linn. Entom., vol. 12, (1857), 1858, p. 231, pl. 3, fig. 35, (Subgen. *Eutermes*); type localities, Antilles and Central America.

(TERMES TENUIS Hagen).

Haviland, Journ. Linn. Soc. Zool., vol. 26, 1898, p. 399.

(LEUCOTERMES TENUIS Hagen).

Silvestri, Boll. Mus. Torino, vol. 16, No. 389, 1901, p. 3; Redia, vol. 1, 1903, p. 38, fig. 7, pl. 1, figs. 33–8.

(TERMES TENUIS Hagen).

Desneux (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Fam. Termitidae, 1904, p. 33, (Subgenus *Leucotermes* Silvestri).

Bahamas, Central and So. America.

Genus ANOPLOTERMES Fr. Müller.

Fr. Müller, Jenaische Zeitschr., vol. 7, 1873, p. 347.

Type *A. pacificus* Fr. Müller.

ANOPLOTERMES FUMOSUS Hagen.

(TERMES FUMOSUS Hagen).

Desneux, (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Family, Termitidae,, 1904, p. 42, (subgenus *Eutermes*).

(TERMES FUMOSUS Hagen).

Hagen, Linn. Entom., vol. 14, 1859, p. 123; type locality, Vera Cruz, Mex.

Tex., Mex.

Genus NASUTITERMES Banks.

Supra, p. 69. Dudley, Trans. N. Y. Acad. Sci., vol. 9, 1890, p. 158 (no species).

Type *T. morio* Latreille.

NASUTITERMES COSTARICENSIS Holmgren.

Holmgren, Mitth. Naturh. Mus. Hamburg, vol. 27, (1909), 1910, p. 237, (*Eutermes*); type locality, Venezuela; Porto Cabello.

Tex., Cuba, Porto Rico, West Indies.

Genus CONSTRICTOTERMES Holmgren.

Holmgren, Mitth. Naturh. Mus. Hamburg, vol. 27, (1909), 1910, p. 208.

Type *Eutermes cyphergaster* Silvestri.

(Genus TENUIROSTRITERMES Holmgren.)

Holmgren, Kgl. Svenska Vetensk. Akad. Handl., vol. 48, No. 4, 1912, p. 65 (type *tenuirostris*).

CONSTRICTOTERMES CINEREUS Buckley.

(TERMES CINEREUS Buckley).

Buckley, Proc. Ent. Soc. Philad., vol. 1, 1862, p. 212; type locality, San Saba County, Tex.

(TERMES CINEREUS Buckley).

Desneux (Wytsman, P., Genera Insectorum, fasc. 25), Isoptera, Fam. Termitidae, 1904, p. 46 (subgenus *Eutermes*).

(TERMES CINEREUS Buckley).

Desneux, Ann. Soc. Ent. Belg., vol. 49, 1905, p. 342.

Tex.

CONSTRICTOTERMES TENUIROSTRIS Desneux.

(TERMES TENUIROSTRIS Desneux).

Desneux, Ann. Soc. Ent. Belg., vol. 48, 1904, p. 288; vol. 49, 1905, p. 341; type locality, Etat de Jalisco, Mex.

(EUTERMES TENUIROSTRIS Desneux).

Holmgren, Mitt. Naturhist. Mus. Hamburg, vol. 27 (1909), 1910, p. 312

Ariz., Tex., Mex.

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Record of the location of existing type specimens of Nearctic Termites.

Species.	Type locality.	Collector and date collected.	Caste.	Location of type.	Type number.	Cotype or paratype.	Location and number of cotype.
Termopsis angusticollis Hagen.	California	M. Hartweg and Ross.	Winged adult	St. Petersburg Museum		Paratype	Museum Comparative Zoology, No. 196.
Termopsis nevadensis Hagen.	Western border of Nevada.	Lieut. W. L. Carpenter, 1873.	do.	(Hagen, 1874) Museum Comparative Zoology.	10107		
Termopsis laticeps Banks.	Florence or Douglas, Arizona.	Snow & Biederman, July and August.	Soldier and winged adult.	Banks's collection Museum Comparative Zoology, Cambridge, Massachusetts.	10547		
Kalotermes occidentis Walker.	West coast Central America (Mexico).	Capt. Wood and Lieut. Wood.	Soldier (2)	British Museum (1 soldier), South Kensington, London, England.		Cotype, soldier, 1	Museum Comparative Zoology, Cambridge, Massachusetts, No. 195.
Kalotermes marginipennis Latreille.	Mexico	Humboldt	Winged adult	Collection of Selys, Longchamps (according to Hagen, 1858).			
Kalotermes approximatus. Snyder.	Ortega, Florida	T. E. Snyder, March 5, 1919.	Soldier	United States National Museum, Washington, District of Columbia.	22359		
Kalotermes minor Hagen.	California		do.	Hagen collection, Museum Comparative Zoology, Cambridge, Massachusetts.	10546		
Kalotermes hubbardi Banks	Tucson, Arizona	E. A. Schwarz, "20/7".	do.	United States National Museum, Washington, District of Columbia.	21855	Paratype, adult	Museum Comparative Zoology, Cambridge, Massachusetts, 10535.
Kalotermes schwarzi Banks.	Adam Key, Florida	T. E. Snyder, May 15, 1916.	Winged adult and soldier.	do.	21856	do.	Museum Comparative Zoology, Cambridge, Massachusetts, 10536.
Kalotermes jouteli Banks.	Adam Key, Florida	do.	Soldier	do.	21857	Paratype, soldier	Museum Comparative Zoology, Cambridge, Massachusetts, 10544.
Kalotermes simplicicornis Banks.	Laguna, Texas (near Uvalde).	T. E. Snyder, May 4, 1917.	do.	do.	21858	do.	Museum Comparative Zoology, Cambridge, Massachusetts, 10545.
Kalotermes texanus Banks.	Chalk Bluff, Texas (near Uvalde).	T. E. Snyder, May 5, 1917.	do.	do.	21859		
Neotermes castaneus Burmeister.	"(St. Francisco) Kalifornien und Portoriko."	Chamisso	Winged adult	Museum Berol* (Hagen, 1858), Berlin, Germany.			

* Berlin Museum.

Record of the location of existing type specimens of Nearctic Termites—Continued.

Species.	Type locality.	Collector and date collected.	Caste.	Location of type.	Type number.	Cotype or paratype.	Location and number of cotype.
Cryptotermes cavifrons Banks.	Kissimmee, Florida	N. Banks, 1906	Soldier and winged adult.	Banks's collection Cambridge, Massachusetts, Museum Comparative Zoology.	10549		
Cryptotermes infumatus Banks.	Cotulla, Texas	F. C. Pratt, Apr. 17, 1905.	Winged adult	United States National Museum, Washington, District of Columbia.	21860		
Reticulitermes flavipes Kollar.	Greenhouses at Schönbrunn, Vienna, Austria.	Kollar, Oct. 12	do	(Hagen, 1858)		*R. flavipes*, cotypes, winged adults.	Hagen collection, Museum Comparative Zoology, Cambridge, Massachusetts, 10110.
Reticulitermes virginicus Banks.	Falls Church or Chain Bridge, Virginia.	N. Banks, June, 1907	Winged adult and soldier.	Museum Comparative Zoology, Cambridge, Massachusetts (Banks's collection).	10548		
Reticulitermes tibialis Banks.	Beeville, Texas	E. A. Schwarz, Nov. 1, 1895.	Winged adult	United States National Museum, Washington, District of Columbia.	21861	Paratypes, adult	Museum Comparative Zoology, Cambridge, Massachusetts, 10542.
Reticulitermes claripennis Banks.	Beaumont, Texas	E. S. Tucker, Mar. 19, 1908.	do	do	21862	do	Museum Comparative Zoology, Cambridge, Massachusetts, 10539.
Reticulitermes hageni Banks.	Falls Church, Virginia	Wm. Middleton, Aug. 11, 1913.	Winged adult and soldier.	do	21863	do	Museum Comparative Zoology, Cambridge, Massachusetts, 10538.
Reticulitermes hesperus Banks.	Little Bear Lake, San Bernardino Mountains, California.	T. E. Snyder, June 1, 1917.	Winged adult	do	21864	do	Museum Comparative Zoology, Cambridge, Massachusetts, 10541.
Reticulitermes lucifugus Rossi.	Shores of the Mediterranean Sea.	1792 ?	do				
Reticulitermes humilis Banks.	Santa Rita Mountains, Arizona.	H. G. Hubbard, May 20, 1898.	Soldier	United States National Museum, Washington, District of Columbia.	21865	Paratypes, soldiers	Museum Comparative Zoology, Cambridge, Massachusetts, 10540.
	do	F. H. Snow, June	Winged adult	do		Paratypes, adult	Museum Comparative Zoology, Cambridge, Massachusetts.
Reticulitermes humilis var. *hoferi* Banks.	Sabino Canyon, Santa Catalina Mountains, Arizona.	Geo. Hofer, May 17, 1917.	Soldier	do	21866	Paratype, soldier	Museum Comparative Zoology, Cambridge, Massachusetts.

Reticulitermes tumiceps Banks.	Stratton, Santa Catalina Mountains, Arizona.	Wm. M. Wheeler	do	Museum Comparative Zoology, Cambridge, Massachusetts.	10543	do	National Museum, Washington, District of Columbia.
Prorhinotermes simplex Hagen.	Cuba	Poeppig	Winged adult	Hof Museum, Vienna, Austria (Hagen, 1858).			
Amitermes tubiformans Buckley.	Lampasas, or San Saba County, Texas.	S. B. Buckley late in autumn 1860.	Worker, soldier, and adult.	Lost			
Amitermes arizonensis Banks.	Fort Grant, Arizona	H. G. Hubbard, July 9.	Winged adult	United States National Museum, Washington, District of Columbia.	21867	Paratype, adult	Museum Comparative Zoology, Cambridge, Massachusetts, 10537.
	Nogales, Arizona	T. E. Snyder, May 21, 1917.	Soldier				
Amitermes wheeleri Desneux.	Belton, Texas	W. M. Wheeler, April, 1902.	Soldier and worker	Museum, Paris, France (?).		A. *wheeleri* Desneux cotype soldier (alcoholic).	American Museum Natural History, New York, N. Y.
Amitermes californicus Banks.	Jacumba, California	F. P. Keen, Aug. 24, 1915.	Soldier	United States National Museum, Washington, District of Columbia.	21870	Paratype, soldier.	Museum Comparative Zoology, Cambridge, Massachusetts.
Amitermes (?) perplexus Banks.	Victoria, Texas	J. D. Mitchell, July 8, 1907.	Winged adult	do	21868	Paratype, adult	Museum Comparative Zoology, Cambridge, Massachusetts, 10533.
Amitermes (?) confusus Banks.	Oracle, Arizona.	E. A. Schwarz, July 2.	do	do	21869	do	Museum Comparative Zoology, Cambridge, Massachusetts, 10534.
Nasutitermes costaricensis Holmgren.			Nasutus and worker	Museum, Hamburg, Germany (Holmgren, 1910).			
Constrictotermes tenuirostris Desneux.	Etat de Jalisco, Mexico.	L. Diguet, 1900	do	Museum, Paris, France (Desneux, 1904*a*).			
Constrictotermes cinereus Buckley.	San Saba County, Texas.	S. B. Buckley, Oct. 22, 1860.	do	Lost			
"*Eutermes*" (?) *nigriceps* Haldeman.	West Mexico	1853	Winged adult	Type not extant			
Anoplotermes fumosus Hagen.	Vera Cruz, Mexico	Sallé, 1859	do	Coll. Selys and Museum Comparative Zoology, Cambridge Massachusetts	218		
Leucotermes tenuis Hagen.	St. Domingo, Port aux Prince, Colombia, Brazil.	Ehrenberg, Moritz, Helm.	do	Museum Berol, Berlin, Germany (Hagen, 1858).		Paratype adult	Museum Comparative Zoology, Cambridge, Massachusetts, 212.

PART 2.—BIOLOGY.

INTRODUCTION.

The second portion of this Bulletin consisting of Biological Notes is by the junior author, and is devoted to a discussion of the habits of Nearctic termites. In the past, due to a much needed taxonomic revision, such a discussion has not been possible. There has not only been much confusion as to the identity of species, but also the literature often attributes habits to Nearctic termites which are possessed by tropical species alone. One can not thus generalize even when dealing with the species of one continent. This is just as flagrant an error as the references to the nightingale as a native bird in American poetry of the Colonial Period.

As in case of Part 1 on taxonomy, our knowledge is as yet very incomplete, and often merely fragmentary. It is hoped that this work will pave the way for a complete monograph. The complex biology of termites offers an intensely interesting field of study.

The character and extent of damage, by Nearctic termites, with methods of preventing and remedying such damage, are outlined.

LIST OF NEARCTIC TERMITES.

- Order *ISOPTERA* Brullé.
  - Superfamily *TERMITOIDEA*.
    - Family *KALOTERMITIDAE*.
      - Subfamily *TERMOPSINAE*.
        - Genus *Termopsis* Heer.
          - Species *Termopsis angusticollis* Hagen.
            - *nevadensis* Hagen.
            - *laticeps* Banks.
      - Subfamily *KALOTERMITINAE*.
        - Genus *Kalotermes* Hagen.
          - Species *Kalotermes occidentis* Walker.
            - *marginipennis* Latreille.
            - *approximatus* Snyder.
            - *schwarzi* Banks.
            - *jouteli* Banks.
            - *minor* Hagen.
            - *hubbardi* Banks.
            - *texanus* Banks.
            - *simplicicornis* Banks.
        - Genus *Neotermes* Holmgren.
          - Species *Neotermes castaneus* Burmeister.
        - Genus *Cryptotermes* Banks.
          - Species *Cryptotermes cavifrons* Banks.
            - *infumatus* Banks.
            - *brevis* Walker.

Family *TERMITIDAE.*
Subfamily *RHINOTERMITINAE.*
Genus *Prorhinotermes* Silvestri.
Species *Prorhinotermes simplex* Hagen.
Genus *Reticulitermes* Holmgren.
Species *Reticulitermes flavipes* Kollar.
virginicus Banks.
hageni Banks.
claripennis Banks.
tibialis Banks.
hesperus Banks.
lucifugus Rossi.
humilis Banks.
humilis var. *hoferi* Banks.
tumiceps Banks.
Subfamily *TERMITINAE.*
Genus *Amitermes* Silvestri.
Species *Amitermes tubiformans* Buckley.
arizonensis Banks.
wheeleri Desneux.
californicus Banks.
(?) *perplexus* Banks.
(?) *confusus* Banks.
Genus *ANOPLOTERMES* Fr. Müller.
Species *Anoplotermes fumosus* Hagen.
Genus *NASUTITERMES* Banks.
Species *Nasutitermes costaricensis* Holmgren.
Genus *CONSTRICTOTERMES* Holmgren.
Species *Constrictotermes tenuirostris* Desneux.
cinereus Buckley.

KEY TO NEARCTIC TERMITES BASED ON BIOLOGY AND PROMINENT STRUCTURAL CHARACTERS.

1. Wood-inhabiting species, not extending galleries from the earth into wood.......2
Wood-inhabiting species, extending galleries from the earth into wood..........5
Earth inhabiting species, not wood-boring—*i. e.*, subterranean....................6
2. Termites usually working in *moist* wood..3
3. Wood eaten longitudinally with the grain; excrement in impressed pellets; pigmented, worker-like form present ....*Termopsis.*
Wood eaten longitudinally with the grain; excrement not in pellets but fluid and seen as spots in the galleries ....*Prorhinotermes simplex* Hagen.
Termites often working in *dry* wood, longitudinal oval chambers excavated in the wood; excrement in impressed pellets; pigmented, worker-like form present or absent 4
4. Head of soldier concave in front, dark or black......................*Cryptotermes.*
Head of soldier flattened and light colored..............*Kalotermes* and *Neotermes* .... *castaneus* Burmeister.
Pigmented, worker-like form absent; hind femora of soldier short and stout ....*Kalotermes.*
Pigmented, worker-like form present; hind femora of soldier long and slender ....*Neotermes.*
5. Prothorax subcordate, mandibles of soldier without marginal teeth..*Reticulitermes.*
Prothorax saddle-shaped, mandibles of soldier with a marginal tooth...... .... { *Amitermes wheeleri* Banks (Texas); *A. californicus* Banks (Calif. and Ariz.).

6. Soldier with two pointed jaws or mandibles absent, but nasuti with central pointed beak present..7
Soldier with two pointed mandibles present..8
Soldier absent; workers gray, with bag-shaped body, and saddle-shaped prothorax ....*Anoplotermes fumosus* Hagen.
7. Nasutus with nonconstricted head..*Nasutitermes*.
Nasutus with constricted head ....*Constrictotermes*
8. Soldier with two pointed mandibles and saddle-shaped prothorax. ....*Amitermes tubiformans* Buckley; *A. arizonicus* Banks?

BIOLOGICAL NOTES.

NESTS.

Unlike some tropical termites, our native species do not construct huge mounds but live in burrows in the earth or in wood. There is no permanent "royal cell," centrally located, in which the "king" and "queen" are imprisoned, and there are no "fungus gardens" or "nurseries." Nevertheless, the nests, or colonies of these social insects, while hidden or nonconspicuous, are as interesting and worthy of study as those of tropical species.

As Haviland (1902) has said:

> Termites inhabit all the warm regions of the earth in countless numbers. They are unable to withstand a prolonged winter's frost. Their greatest enemies are ants. Their chief means of defense is their power of burrowing and building.

Our native termites may be divided by their habits into three groups: Wood-inhabiting species, which do not burrow into the ground; those which live in the ground and infest wood indirectly through the ground, and earth-inhabiting species, which do not burrow in wood. Species in both the latter groups may be termed subterranean termites.

SUBTERRANEAN SPECIES.

The termites of this group belong to the family Termitidae, subfamilies Rhinotermitinae and Termitinae. All of the species in the subfamily Rhinotermitinae of the genus *Reticulitermes* and some species of *Amitermes* are essentially wood destroyers and live in forests, building their nests in the wood of dead trees, decaying logs and stumps; in the foundation timbers of buildings, fences, and any wood in contact with the ground; or in a labyrinth of underground passages in the earth, usually underneath wood or vegetation.

These subterranean termites are the most injurious to the foundation timbers, woodwork, and contents of buildings. The species of *Reticulitermes* even bridge over substances they can not penetrate, such as metal or stone, brick, or concrete foundations, by means of small shelter sheds or granular, earth-like tubes constructed of earth and excrement extended up from the ground. (Fig. 60.) These tubes have been called the "adobe houses" of white ants (pl. 5). The suspended tubes, constructed by *R. claripennis* Banks from the infested wooden beams which supported the flooring of a building of the Kansas State Agricultural College at Manhattan, Kans., were 3 to 8 inches long and more or less flattened. The tubes ended 2 or 3 feet above the ground. Termites are soft-bodied and always conceal themselves within the wood or within their tubes. In burrowing through wood they often completely honeycomb it, usually following the grain and eating out the softer, thin-walled, larger-celled spring or new wood. The species of *Reticulitermes* are able to penetrate the hardest of woods, and even attack dry, seasoned wood, provided there is access to moisture in the ground. They carry moisture with them in extending their galleries by means of moist excrement mixed with earth up to even the second and third floors of buildings.

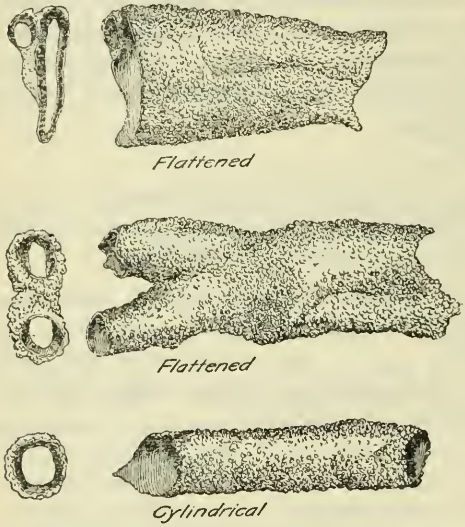

Fig. 60.—Reticulitermes flavipes. Suspended tubes constructed by workers from broken off pine tree to ground. × 3.

Since the excavators (the workers) are soft-bodied, lack pigmentation, and are blind, there are many enemies to the colony, and it is often necessary to come above ground in order to attain access to wood. How is this difficulty solved? They take the ground out along with them and either construct covered runways or tunnels by plastering it on the surface or carry moist earth into their galleries within wood. Thus they are enabled to travel far from the ground and its necessary moisture, even to the tops of trees and the third floor of buildings.

Charles Darwin's conclusions regarding the rôle of the earthworm of temperate zones in furthering the natural fertility of the soil by constantly turning it over, plowing it, and carrying it to the surface in their excavations are well known.

Prof. Henry Drummond (1889), in Chapter 6 of "Tropical Africa," compares the rôle of subterranean termites of the Tropics to that of the earthworm. There is a constant circulation of earth—a plowing and a harrowing, pellet by pellet, grain by grain. Furthermore, the vegetable substances taken as food by the termites pass through their bodies to enrich the soil just as similar substances pass through the bodies of the earthworms for a similar purpose. By their underground excavations they keep the soils in a constant circulation.

Since these termites always require access to damp earth, if this source of moisture is shut off, the insects will not be able to extend the galleries in wood farther and will perish.

In the Appalachian Mountain region and in the canyons of the Arizona Highlands, colonies of *Reticulitermes* under stones are more common.

In Arizona some species of *Reticulitermes* also live in the wood, roots and stems of various species of cactus (*Opuntia*) and the dry, hard, woody ribs of the giant cactus (*Cereus giganteus*), and in ocotillo (*Fouquieria splendens*).

In the prairie regions of the "Prairie Plains" and the "Great Plains" areas, species of *Reticulitermes* occur. In Kansas these termites live in large numbers in the heavily sodded prairie, feeding on the roots of the vegetation.

In Utah and Colorado, *Reticulitermes* infests the roots and stems of sage brush and scrub oak on foothills and in canyons. In Colorado, however, *R. tibialis* Banks is found on the mountains in the Pikes Peak region at an altitude of approximately 7,000 feet. It is interesting to note that no living termites were found by the writer in a two-day collecting trip in the vicinity of the famous fossil beds at Florissant, although a large fossil termite was secured which had been dug out by Mr. George W. Wilson. Florissant is at an altitude of 8,193 feet above sea level, in a region of low rolling hills and valleys, with gravel and sand; the vegetation consists of grass, pine, aspen, and occasional spruce.

In the "Great Basin" region species of *Reticulitermes* are able to live and survive in the dry, arid, dusty desert and foothill areas in the vicinity of the Ruby Mountains, Nevada (near Elko and Lamoile), by burrowing in the woody roots and stems of sage brush (*Artemesia tridentata*) and low junipers (*Juniperus*, species).

The species of *Reticulitermes* migrate readily; they change their location within the nest, according to the season or with temporary changes in temperature or moisture, and even the entire nest may be moved to a new site if conditions are unfavorable.

A single *Reticulitermes* colony or nest may extend into several adjacent stumps, trees, or logs.

As compared with the large-sized *Termopsis*, which requires large stumps, logs, or trees, *Reticulitermes* can inhabit decayed wood of relatively small dimensions. This is due to the fact that in the case of *Termopsis* there are no subterranean passages, the wood only being inhabited. If the reproductive forms of the first form be removed from a colony of various species of *Reticulitermes*, the insects abandon the nest, or at least that portion of the nest which is above the surface of the ground.

In the subfamily Termitinae some species are destructive wood-borers and others injurious to growing vegetation.

Amitermes wheeleri Desneux in Texas is a destructive wood-borer, boring through and honeycombing the hardest wood (pl. 7). It is probable that *A. californicus* Banks has similar habits but not *A. tubiformans* Buckley. In regions where there is little or no wood *A. wheeleri* lives in the roots and lower rosettes of the leaves of the plant called by the Mexicans "Lechuguilla" (*Agave*, species). It has also been found burrowing in the dry dead flower stalks of *Agave* and under and in chips of dry cow manure.

A. californicus also has similar habits in regions where there is little or no wood.

In the prairie or semiarid regions of Texas, *Amitermes tubiformans* Buckley lives in the ground, in pasture tracts, feeding on the roots of grass and other vegetation, often being found within and under dry cow dung and under stones. This species has the destructive habit of covering grass and other vegetation with earth-like tubes, thereby killing it. Another species of *Amitermes* (*arizonensis* Banks) lives in arid and desert regions in Arizona. These two species of *Amitermes* are not wood-borers. Species of *Constrictotermes*, *Nasutitermes* ("*Eutermes*"), and *Anoplotermes*, while subterranean and injurious to vegetation, so far as is known, do not damage wood in the Southwest. They live in the ground under stones, logs, and cow chips. During dry seasons, when the earth is caked and cracked, these termites, especially "*Eutermes*," are difficult to find, for their burrows extend deep into the soil and they themselves retreat far below the surface. The most favorable localities under such conditions are moist meadows or along the banks of irrigation ditches, or under fairly moist chips of cow manure.

In case of some species of earth-inhabiting (subterranean) termites, which occur in the southwestern United States, in the worker caste, the tibiae of the prothoracic legs are enlarged—that is, markedly swollen or subfusiform and spinose—subfossorial legs—used in digging, yet not greatly modified (Snyder, 1919). Possibly this is an adaptation for digging in the soil which often becomes caked and hard. However, worker termites, where observed excavating, invariably carry away particles of earth in their mandibles and then return for other particles.

Termites with the tibiae of the prothoracic legs markedly fusiform are *Amitermes tubiformans* Buckley, *A. arizonensis* Banks, *A. wheeleri* Desneux, *A californicus* Banks, and *Anoplotermes fumosus* Hagen. In *Anoplotermes fumosus* the shape of the tibiae and tarsi give the leg a peculiar short and stubby appearance (pl. 8, figs. 1–8);

at the extremity of the prothoracic tibiae there is a chitinized area on the dorsal surface.

Workers of *Constrictotermes tenuirostris* Desneux, *C. cinereus* Buckley and *Reticulitermes flavipes* Kollar, do not have a marked distinction between the tibiae of the prothoracic and mesothoracic legs, although these termites are also earth-inhabiting.

All subterranean or earth-inhabiting termites have a worker caste. No termite which does not live in the earth has a worker caste, except *Prorhinotermes simplex* Hagen.

These subfossorial tibiae may be explained as "chance variations" that have proven useful and have hence survived.

On the famous expedition of Webster and Schaupp for Beaver parasites, the late Prof. F. M. Webster found a colony of *Constrictotermes cinereus* Buckley in a beaver's nest at Devil's River, Texas, on March 23, 1891. In this case, of course, the termites were merely taking advantage of a favorable situation for a nest.

As Haviland states (1902) of species of "*Eutermes*":

> * * * Long legs [longer than abdomen] and long antennae [fig. 54, 3] [also a saddle-shaped pronotum] go with much walking and foraging [species of *Constrictotermes* and *Nasutitermes*—the workers and soldiers of which are also pigmented and wander about above ground. Another peculiarity is that the worker is larger than the soldier or nasutus (*Constrictotermes cinereus* Buckley).] * * * Soldiers with short, stout legs belong to species sluggish in their movements, and which venture but little from home.

WOOD-INHABITING SPECIES.

Our native wood-inhabiting species, which are not subterranean, belong to both of the two families of Nearctic termites—that is, Kalotermitidae and Termitidae. Of the former, all of the subfamilies and genera are in this group, that is, Termopsinae and Kalotermitinae; genera *Termopsis* Heer, *Kalotermes* Hagen, *Neotermes* Holmgren, and *Cryptotermes* Banks. In the latter family only one species of the subfamily Rhinotermitinae, namely, *Prorhinotermes simplex* Hagen, is not subterranean.

The species of *Termopsis* live in the moist, decaying wood of logs and stumps, usually inhabiting regions where coniferous trees predominate. They never leave the wood to burrow in the ground and they infest the wood directly through holes, under loose bark and decayed areas. So far as is known they are not particularly injurious species, which is unusual among termites. The pellets of excrement are impressed—that is, slightly grooved or marked by longitudinal lines (pl. 9); they are more moist and usually less regular than the pellets of species in the subfamily Kalotermitinae, and are often either massed together in the burrows or are expelled and fall to the ground.

Kalotermes, *Neotermes*, and *Cryptotermes* bore lengthwise through the hard, dry wood, and, instead of following the grain, excavate longitudinal chambers. Their pellets of excrement are regularly impressed and these sometimes completely fill or block up the burrows with a compact mass (pls. 9 to 12). They are often expelled as dry droppings from the infested wood. These termites are destructive to the woodwork and furniture in buildings. The species of these three genera never burrow in the ground.

In Arizona various species of *Kalotermes* burrow in the dry wood of dead cottonwood, poplar, walnut, and "palo verde" trees, also living in hardened wounds of the giant cactus (*Cereus giganteus*). There is a record of injury to the root of a pear tree by a species of *Kalotermes* at Mineral Park, Mohave County, Arizona, on May 17, 1890.

Prorhinotermes simplex is similar in habits to species of *Reticulitermes*, except that it is not subterranean. This termite is a destructive wood borer and injurious to timber.

FOOD.

The principal food of termites is cellulose, which they obtain from dead or living vegetation. Dr. M. Oshima, expert zoologist, Goverrment of Formosa, has kept termites alive by feeding them on filter paper or cotton. Oshima has proven that when they eat the spring wood, the hard lignin-cellulose is not digested, as can be verified by testing with hydrochloric acid, when the lignin reaction is obtained.

The young are fed on prepared food which is fed from the mouths of the adult insects.

Workers, soldiers, and nymphs often solicit liquid from the anus of other termites, especially from the reproductive forms. This subject will be discussed later under the heading "Trophallaxis."

DAMAGE.

CHARACTER AND EXTENT OF DAMAGE DONE BY TERMITES.

Hagen (1876) states that termites retreat step by step before advancing cultivation. However, this is only partially true. When their breeding places in dead trees, logs, and stumps are destroyed they then infest fences, telephone poles, and the foundations and woodwork of *poorly constructed* buildings.

It has already been noted that species in the various genera show very characteristic differences in the manner in which they bore through wood, and their work or "Frassbilder" (Assmuth, 1913) is quite distinct. The impressed pellets of excrement expelled by some species enable generic determination. Dudley in his paper on "The Termites of the Isthmus of Panama" (1890) writes that the various species can be distinguished by their work, galleries, and nests, and that the remedy in each case must be different. These facts are all very useful in combating these insects.

In the United States damage by termites to the woodwork of buildings and to their contents, while not so great as in the Tropics is the cause of a serious annual loss. The genus which causes the most damage is *Reticulitermes*. Some damage is caused by *Kalotermes* and *Cryptotermes*.

Termites bore through books, paper, clothing, shoes (pl. 13), food, and substances stored in dark and damp places. Important documents stored in departmental buildings at Washington, District of Columbia, are sometimes found to be damaged or destroyed by termites. The Division of Forest Entomology of the Bureau of Entomology, United States Department of Agriculture, during the fiscal year 1916, received 37 requests for information about these insects and advice as to the methods of getting rid of or preventing termites from infesting the woodwork of buildings in the United States. Fifteen cases of such damage by various species of *Reticulitermes* occurred in the city of Washington. During the fiscal year 1917, 47 requests for similar information were received; 9 were in the city of Washington; during the fiscal year 1918, 39 requests were received, 13 cases being in Washington. During the fiscal year 1919 there were 42 reports of termite damage to buildings; 12 were in Washington.[1]

Often it has been found necessary to advise reconstruction of the foundation and flooring of buildings, involving expenditures of from $50 to $3,000.

In the eastern United States such damage has occurred as far north as Boston, Massachusetts, Manchester, New Hampshire, and Benton Harbor and Grand Rapids, Michigan; on the Pacific coast, at Portland, Oregon. Termite damage to the woodwork of buildings is naturally more common and serious in the Southern States.

In several instances the damage by *Reticulitermes* was done to large buildings, as in the old building of the Bureau of Engraving and Printing in Washington; a hospital in Jersey City, New Jersey; a railroad station in Baltimore, Maryland; churches in the city of Washington, and several large and expensive residences in the cities of Washington, Baltimore, New Orleans, St. Louis, and elsewhere.

An unusual case of damage by termites (*Reticulitermes*) was reported in May, 1918. In a cold-storage plant, at Portsmouth, Virginia, these insects caused considerable damage; the isolation was of sawdust and wood.

Untreated wall board, made from wood pulp, used for interior finish and as substitutes for lath, etc., is damaged by termites in the Southern States. Damage to telephone and telegraph poles, mine props, railroad ties, and other timber in contact with the soil is considerable, especially in the Southern States.

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[1] This enumeration of the number of cases of damage by termites to the woodwork of buildings annually reported to the U. S. Bureau of Entomology does not, of course, represent the total number. When the public in general becomes educated and learns of the serious losses caused by these insects through our publications and personal correspondence, doubtless there will be a gradual but temporary increase in the number of reports of damage. However, householders will soon insist that contractors construct buildings properly so as to be "white ant" proof and there will be a rapid and permanent decrease. Termite damage to buildings occurs from coast to coast, but is particularly serious in the Southeastern, Gulf, and Southwestern States.

D. C. Parman, of the Division of Southern Field Crops of the Bureau of Entomology, in charge of Dr. W. D. Hunter, made observations on the relation between insect life and the typical West Indian storm which visited southwest Texas on the night of August 18, 1916. In notes on termite damage Mr. Parman states:

> Places were noted where termites[1] had made nests in the bottom of the untreated telephone poles of some of the country lines. The termite work was in evidence at nearly all of the wood windmill towers, and it was a noticeable fact that the wooden towers were blown down, while only the mills on the steel towers were wrecked. Termites did much damage to crops blown down, and in a few cases where sorghums had been headed and the heads piled on the ground they were covered with dirt by the termites.

Termites occasionally injure a great variety of living trees, bushes, shrubs, flowers, and field crops. These insects may be considered a serious greenhouse pest; such buildings are always warm and moist and untreated woodwork and growing plants are especially liable to attack. Termites injure flowers by tunneling and hollowing out the roots and stems. (Pl. 14, fig. 1.)

Practical methods of preventing and remedying damage to timber, the woodwork of buildings and their contents, or injury to plants by termites have been devised and information can be obtained by corresponding with the Bureau of Entomology, United States Department of Agriculture. Methods of preventing damage to buildings will be briefly set forth here.

Remedies and Preventives.

Different remedies and preventives must be instituted in case of damage by the two groups of termites, namely, the subterranean and wood-inhabiting termites.

Nearly all cases of damage to buildings by subterranean termites are due to the fact that they have been carelessly or poorly constructed.

SUBTERRANEAN TERMITES.

A prevalent idea, even among entomologists, is that termites infest old buildings only. As a matter of fact it is not necessarily the age of a building but the manner in which it is constructed that renders it liable to attack. *Improperly constructed* new buildings one, two, or three years old are often badly infested.

The remedy is complete insulation or isolation of all untreated wood from the ground.

Where possible, construct buildings entirely on raised foundations of stone, brick, or concrete, including stone columns or pillars in the basement to support the floor above; make the walls and flooring in the basement or cellar also of concrete, and lay concrete floors on a gravel base.

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[1] Probably species of *Reticulitermes* and *Amitermes wheeleri* Desneux.

Lay basement window sills and frames over concrete and do not allow the woodwork to come in contact with the ground. Never sink untreated timber in the ground or in moist concrete; let there be no untreated wood in contact with the ground through which the termites may come up from subterranean galleries.

Complete dryness of the foundation and basement walls and flooring is an important means of rendering buildings safe from attack; therefore provide for air spaces between the ground and wooden flooring and lay concrete floors on a gravel base.

Since these termites always require access to damp earth, shut off this source of moisture, and the insects will not be able to extend the galleries farther and will perish. By shutting off termites (already in the wood) from the source of supply of moisture in the ground, they will die out, since they can not live without moisture. It is not necessary to do anything more to kill them; the insects will die absolutely when the infested beams are disconnected from the earth. In military parlance: Shut off these termites from their base—that is, moisture supply in the earth—and the vanguard, no matter how great in numbers, infesting the timbers, will soon dry up. This must be emphasized to owners of infested buildings, since this knowledge will save time and expense, especially in case of old frame buildings, where extensive repairs would be unwarranted. For example, if the source of ingress to the building were shut off by disconnecting the untreated foundation timbers from contact with the soil, the termites will die in the other woodwork, furniture, and stored material in the building, even if they had penetrated to the second or third floors. Furthermore, these timbers need not be removed or replaced unless structurally seriously weakened; the termites will dry up.

Termites also injure living trees, shrubs, field crops, nursery stock, and flowers, both in gardens and in greenhouses. Much injury by termites can be prevented by clean cultivation and proper horticultural management. Injury is more common in the new soil of recently cleared woodland, containing old decaying stumps, wood, or much leaf mold. Fence posts should be treated with coal-tar creosote. Old boards or wood should not be allowed to lie on the ground near fruit trees or in gardens. Prunings should not be left on the ground but should be burned. Where termites are destructive do not use animal manure.

Care should be taken that living trees should not be scarred at the base.

In case of species of termites which are not wood borers but are subterranean in habit and injure living vegetation, as species of *Ami-*

termes, clean cultivation is to be recommended. Stubble should be well turned and the fields plowed during the fall and winter.

NONSUBTERRANEAN TERMITES.

Termites that do not live in the earth of the genera *Kalotermes*, *Neotermes*, and *Cryptotermes*, subfamily Kalotermitinae, can not be combated as the subterranean species by shutting them off from their supply of moisture in the earth. They even infest dry wood directly through crevices, cracks, or decayed places; they do not require much moisture. Of course, their breeding places in decayed wood should be destroyed. Where these species are abundant, windows and doors in buildings should be screened, especially during the period of swarming or flight. In unscreened buildings the lights should be put out during the swarm. Fumigation with hydrocyanic acid gas[1] will kill these termites in furniture, stored material, or exposed timbers of small dimensions. Since species in these genera swarm at night and are attracted to lights in large numbers, the winged adults can be trapped by catching them in large shallow receptacles full of oil or water and placed under lights.

The unprotected woodwork of buildings should be treated with chemical wood preservatives.

Function of the Swarm or Aerial Colonizing Flight.

The terms "swarm" and "nuptial flight" are not appropriate in referring to the emergence of the winged sexual adult termites, which is merely a colonizing flight. After a short flight the males and females alight on the ground and separate into pairs.[2] There is a marked sexual attraction and the males follow the females about. The females find a suitable site for the new colony and the pair become established. Sexual mating or copulation does not take place at the time of the swarm, which is therefore not a nuptial flight. Neither does copulation take place immediately after the swarm, but only after the pair are established in the new colony and the sexual organs have matured. Usually males and females from the same colony mate, but sometimes they mate with individuals from nearby colonies which are swarming at the same time.

These insects that have taken this flight never return again to the same colony—that is, the parent colony—but form new colonies.

Usually the colonizing adults of the same species make their first flight, which is the largest in numbers, at the same time, over a wide area of country. This annual production of winged sexual adults in enormous numbers is undoubtedly for the further diffusion and perpetuation of the species; a wider diffusion can be accomplished by flight than through subterranean tunnels; furthermore, places otherwise inaccessible can be reached; for example, some termites have colonies in the buttresses of the few remaining large bald cypress trees (*Taxodium distichum*) in Lake Drummond, Dismal Swamp, near Wallacetown, Virginia. (Pl. 15.)

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[1] 1916. Howard, L. O. and Popenoe, C. H. Hydrocyanic-acid Gas Against Household Insects, Farmers' Bull. 699, U. S. Dept. Agric., April.

[2] Species of *Reticulitermes*.

Unless carried by the wind, termites do not fly very far. The great majority of the colonizing adults in the genus *Reticulitermes* and other subterranean species, after a short vacillating flight, alight or fall to the ground and lose their wings. The night-flying species of the family Kalotermitidae are stronger fliers.

DIURNAL SWARMING.

The species of *Reticulitermes* in the eastern United States (north of Georgia) always swarm during the daytime; in the vicinity of Washington, District of Columbia, usually in the morning or about noon. The species of this genus have never been collected at lights, at night, so they are probably not nocturnal in habit. Rainfall is not a factor that induces swarming in the more humid east.

Amitermes tubiformans Buckley and *perplexus* Banks swarm during the day in Texas.

Small, inconspicuous termites swarm during the daytime.

NOCTURNAL SWARMING.

Species of the genera *Termopsis*, *Kalotermes*, *Constrictotermes*, and *Nasutitermes* are night-flying termites, and their winged adults have been collected on the wing at lights at night, to which they are attracted. In the case of *Termopsis angusticollis* Hagen and *nevadensis* Hagen the swarm usually begins at dusk, but the insects continue to fly until late in the evening. The same is true of *Kalotermes*. Large, conspicuous termites swarm at night.

In arid or dry sections of the country, as in certain portions of the Southwestern States, on the prairies and Great Plains, termites usually swarm after a rainfall or during a light drizzle, as is characteristic of many termites in the Tropics. This is because of the dry hard ground in which otherwise the insects could not become established. These conditions do not prevail in the eastern United States, where the ground is usually more moist and favorable.

SEASONAL AND OTHER VARIATIONS OF SWARMING.

The different species of a genus rarely swarm at the same time in the same locality.

The dates of swarming, or the colonizing flights of termites, vary with the species and the geographical location, and also with the season. Observation has shown that the dates of termite swarming can be correlated with the seasonal development of certain forest trees, and that the actual dates of the month are of no importance.

There may be several swarms from one colony, distributed over a period of several weeks. The first outdoor flight of *R. flavipes* Kollar in the vicinity of Washington, District of Columbia (and, as mentioned above, the first swarm contains the greatest number of individuals), occurs simultaneously with the ripening of the pollen of the eastern flowering dogwood (*Cornus florida*), which is also influenced by seasonal and geographical variations.

R. virginicus Banks does not swarm outdoors, in the vicinity of the city of Washington, until after the mountain laurel (*Kalmia latifolia*) and the chinquapin (*Castanea pumila*) are in full bloom, usually a full month later than *flavipes*.

R. hageni Banks swarms, in the vicinity of Washington, District of Columbia, about two months later than *virginicus*.

Reticulitermes hesperus Banks swarmed in the San Bernardino Mountains, California (near Little Bear Lake) in 1917 on June 1. The dogwood (*Cornus nuttallii*) then had flowers with ripe pollen.

J. Brunner states that sexual adults of *Termopsis nevadensis* Hagen were first observed in flight near lights, near Missoula, Montana, when the pollen began to fall from the yellow pine (by June 15, 1916).

Dr. A. D. Hopkins, since 1895 (Hopkins, 1918) has made extensive observations in phenology, noting the correlation between the seasonal development of plants and insects. He states that the variation due to latitude, longitude, and altitude from a date at Washington, District of Columbia, will be approximately four days for each degree of latitude, 5° of longitude, and 400 feet of altitude, being earlier in the season southward, westward, and descending. Therefore, the swarm would be over relatively earlier at parts south of Washington and westward and later northward. Washington is at approximately latitude 39° and longitude 77°, and practically at sea level.

In buildings infested by termites the time of swarming is greatly influenced by the artificial heat, and the swarm from indoor infested timbers may occur one or two months earlier than under natural conditions.

Colonies of the same species of *Reticulitermes* may swarm at different periods of the year; as, *R. flavipes* Kollar usually swarms in the spring, yet winged adults were collected by the junior author on November 3, 1915, at Meldrim, near Savannah, Georgia, and in November, 1917, by E. B. Griffen in telephone poles; and at Bergen Beach, New York, September 14, 1908. *R. claripennis* Banks swarms in both the spring and the fall in Texas. *R. tibialis* Banks in Kansas swarms in September and in both fall and winter in Texas. At Colorado Springs, Colorado, this species swarmed the first part of April in 1915; in 1917 winged adults were collected on September 9 by W. D. Edmonston.

Foundation of New Colonies.

SWARMING.

At the proper season of each year the winged colonizing males and females are impelled to emerge in enormous numbers from colonies. The insects usually crawl up on some elevation before taking flight.[1] Numerous workers and soldiers are congregated near the exit holes at the time of the swarm. Termites[2] are weak fliers and are preyed upon by many forms of animal life.

LOSS OF WINGS.

In species of *Reticulitermes* and other subterranean termites the wings are lost after the insects have taken a short, irregular vacillating flight and alighted to the ground. The wings are pried off by the insect catching the tips against some object and then turning sideways. The wings break off at a suture or line of weakness near the base, leaving stubs. These triangular basal portions or stubs of the wings are thickened and more chitinized than the wing proper, and are also pubescent up to the suture—a possible aid in breaking off the wing. Courtship follows the loss of the wings.

In the family Kalotermitidae the species do not lose the wings until just before or after the males and females become established in the new colony.

In the subfamily Termitinae the species sometimes lose the wings while in the air. Various species of *Amitermes* have this habit in Texas, the deälated insects falling to the ground.

COURTSHIP.

Separation into pairs.—Species of *Reticulitermes* go through an "amatory procedure" or a kind of courtship immediately before or after the loss of wings, preliminary to mating.

The male follows the female tirelessly and persistently, with head close to her abdomen, and touches her abdomen with the antennae. Often the male and female run in a circle of small diameter, and sometimes the pursued turns pursuer, apparently attracted by some secretion at the posterior end of the body. Sometimes as many as three individuals may be seen running off together. This is apparently due to sexual attraction, an amatory procedure preliminary to pairing, which accomplishes the purpose of bringing the sexes together. This continues for several days after the flight. The sexes are attracted to each other at a period several days before swarming, as is evidenced by the fact that when a colony is broken into there is a short flight, followed by loss of the wings, after which the male follows the female in the same manner as after normal swarming.

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[1] Fuller (1915) records peculiar mating habits of species of *Termes* in South Africa, that is, a "calling attitude" of the females on grass stems violently agitating their wings. Winged adults of species of *Reticulitermes* in eastern United States climb up on grass stems (and other elevations) and agitate their wings at the time of the annual emergence but this is to get a start for their flight.

[2] Species of *Reticulitermes.*

In the genera *Termopsis* and *Kalotermes* the males and females do not run about in pairs; that is, no courtship takes place. (Haviland, 1902.)

There is an enormous mortality among the winged colonizing termites during and after the swarm, and a still further diminution of their numbers takes place through the inability of some individuals to become established under favorable conditions; yet in spite of all these losses some pairs are established and all the colonizing adults are not "irretrievably lost."

There is a considerable difference in the procedure of the location of the site in the establishment of new colonies in the two families Kalotermitidae and Termitidae, and this will be discussed under the various species belonging to the two main groups: The forms which inhabit both earth and wood, and those which inhabit wood only.

Mating and Egg Laying.

The deälation, courtship, and separation into pairs is followed by the location of a favorable site for the new colony.

The first coition probably occurs about one week after the swarm in case of species of *Reticulitermes* (Snyder, 1915).

Copulation, therefore, does not occur in the air during the swarming, which is in no sense a marriage flight, nor immediately after the swarm, but only after the establishment of the new colony and after the sexual organs have matured.

The manner of copulation of termites has been described by Grassi (1893), Heath (1903), and Odenbach (Snyder, 1915). The Rev. F. L. Odenbach, in describing the mating of reproductive individuals of the second form of *Reticulitermes flavipes*, on December 27, 1899, writes:

> The introduction is a lively play with feet and feelers, heads looking in opposite ways, the bodies curved together so as to make a circle; then the male slips along the body of the female until the organs meet; then they stand in one line, heads looking in opposite directions. The body is moved backward and forward, hinging on the legs and finally to both sides, as if they wished to telescope the abdomens. Time of connection, about one minute.

In incipient colonies after the first coition, in case of species of *Reticulitermes,* there is no further union until the first brood of young has matured. After this, copulation is repeated at shorter intervals and more frequently throughout the life of the pair, for, unlike the honey bee, the male termite continues to cohabit with the female. These intervals appear to be irregular.

The reproductive forms are not necessarily monogamous; sometimes one male and two females, or the opposite, are found in the same cell; but these deälated reproductive forms, unlike the apterous forms, are not normally polygamous. The reproductive individuals of the second and third forms are always polygamous.

The rate of egg laying in the queens of Nearctic termites is relatively slow and is not comparable to that of tropical species.

None of the different forms of queens of any of our native termites ever completely lose the power of locomotion on account of the distended abdomen, and they do not reach the enormous size attained by species in the Tropics; there is, in consequence, no centrally located royal cell.

The rate of egg laying in newly established or "incipient" colonies of Nearctic species of termites is slow. In species of *Reticulitermes* and *Kalotermes* 6 to 12 eggs compose the first batch. Species of *Termopsis* have a slightly greater initial rate of egg laying (Heath, 1903); 15 to 30 eggs are laid by young parent adults of *T. angusticollis.*

In well-established colonies of Nearctic termites tens of thousands of eggs are present, and, allowing for a period of incubation of 10 days to 2 weeks, the rate of egg laying must be rather rapid. Old mature queens lay continuously at least one dozen eggs in 24 hours. However, sometimes 40 to 100 reproductive individuals of the second form are present in the same colony.

In the southeastern United States, in old long-established colonies of species of *Reticulitermes*, egg laying takes place from April to October; that is, during the warm months. In infested heated buildings occupied by man, eggs are produced in every month of the year.

The eggs occur in clusters and are tended by the young parent adults in the royal cell in incipient colonies. In long-established colonies the eggs are removed from the royal cell by the workers and deposited in clusters in the outlying galleries of the colony, where conditions are best suited for hatching. The eggs are yellowish-white and reniform.

There are differences in the size of the eggs of the subfamilies of termites (pl. 35), the eggs being largest in the primitive species.

EGG LENGTHS OF NEARCTIC GENERA OF TERMITES.

Genus of Termite.	Length in mm.
Termopsis	1.48 to 1.7
Kalotermes	1.2 to 1.625
Neotermes	1.6
Cryptotermes	1.2 to 1.3
Reticulitermes	.6 to .7
Prorhinotermes	.68 to 1.0
Anoplotermes	.56 to .65
Nasutitermes	.64 to .72
Constrictotermes	.75
Amitermes	.56 to .64

METAMORPHOSIS.

The newly hatched forms of all castes of termites were formerly considered to be alike, or "undifferentiated," but the work of Thompson (1917) has disproved this. Thompson states that at the time of hatching there are two kinds of nymphs[1]—the "reproductive" and the "worker-soldier" nymphs, which develop into the fertile or reproductive castes, and the sterile castes, and which may be distinguished by internal differences in the brain, the composite eyes, and the sex organs.

The metamorphosis of termites is of the type known as incomplete or ametabolic metamorphosis, and, in the case of the worker caste, there is very little external change during the development, the newly hatched worker-soldier nymph being active and similar to the adult worker in all but size. The development of the worker is, therefore, a gradual growth, the semitransparent large-headed nymphs undergoing several molts which are preceded by temporary periods of inactivity known as quiescent stages (Strickland, 1910; and Snyder, 1913 and 1915).

The exact number of molts of the castes of any Nearctic species of termite is not known, and further investigation of this subject is needed.

In the soldier and "nasutus" caste the metamorphosis is marked by very considerable external and internal changes. In *Reticulitermes* the soldier caste is differentiated late in the development, the young soldier with rounded head and but slightly elongated jaws emerging after a quiescent stage of short duration from a workerlike skin (Snyder, 1913). Both workers and soldiers complete their development within one year.

The development of the small-headed or reproductive nymphs is also gradual, lasting about two years, and is marked by the external changes caused by the growth of the wing pads and wings.

In all stages of the development of our native termites the insects are active, except for these quiescent stages of comparatively short duration. Furthermore, in all these developmental stages, unlike in insects with complete metamorphosis, the adult, or what may be superficially termed the "antlike" form, may be distinguished.

CASTES OF TERMITES OR THE TERMITE COLONY.

In termite colonies or social communities, as in the colonies of ants, there are several different forms or castes of adult insects besides eggs and the developmental stages of the different castes in various stages of growth.

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[1] The term "nymph" is used, in the sense of Thompson (1916), to denote any developmental stage of insects with incomplete metamorphosis, instead of the two terms "larva," and "nymph," which were formerly used to denote, respectively, nymphs without the beginnings of wing pads, and nymphs which had developed the beginnings of wing pads.

The castes are the three types of reproductive forms and the wingless and normally sterile workers and soldiers. The three reproductive castes follow the nomenclature of the three types of nymphs from which they have arisen, and are called reproductive adults of the first form, second form, and third form (Thompson, 1917). In tropical species of some genera there are two different types of soldiers, or, more rarely, of workers, so that there may be as many as seven different adult forms in the same colony.

The different types of reproductive forms.—As has been previously stated, there is no definite, centrally located "royal cell," as in tropical species of termites. There is always an element of unusual interest connected with searching for and finding the queen. In species where there is a centrally located "royal cell" success is only a question of time, patience, and labor. Certain savage peoples search for these large queens for food and they are considered quite a delicacy. It was once thought that, since the queen mother was the source of the colony life, if she were destroyed the termite colony could be exterminated. This, of course, has been disproved by more recent investigation of the insects, revealing a complex life cycle.

In case of our native termites, "true queens" were thought either to be very rare or not to exist until quite recently; this idea has been disproved by Joutel (1893), Hubbard and Schwarz (1901), Schaeffer (1902), Heath (1903), and the junior author (1912). An historical account of the first finding of these forms in the United States is given by the junior author (Snyder, 1915). In searching for the cell which contains the "queen" it must be remembered that its location depends upon the species and the habits of the termite and, in some degree, upon the season of the year. The fact must also be borne in mind that termites have several different types of reproductive forms. The commonest type is the deälated, colonizing, sexual adult, developed from nymphs of the first form; that is an adult queen of the first form. Queens of this type reach the largest dimensions.

Unlike most insects, there is an actual "post-adult" growth in the case of the older termite queen with distended abdomen (fig. 61, 1), due chiefly to the development of the ovaries (pls. 27, 28, and 29), but there is in addition a multiplication of cells, as fat cells, and blood cells. After feeding and a later inflation of the body with fat, together with the development of the sex organs, the abdomen of the male or king also becomes slightly increased in size (fig. 61, 2). The males of both the first and second reproductive types continue to cohabit with the queen and there is repeated copulation.

Another type of reproductive form is that of the "second form" (Thompson, 1917) with short wing pads, varying in length. This type is developed from the nymph of the second form (Lespès) with short wing pads; it is common in colonies of species of *Reticulitermes* in eastern United States. There are usually many females and a few males congregated in a large chamber. Unlike the reproductive individuals of the first form, these males and females have not the chitinized parts deeply pigmented and have no functional eyes; the compound eyes are palely pigmented. The characteristic pigmentation is straw colored or grey. (Fig. 62.) They never leave the colony unless by subterranean tunnels. A male of the first form is sometimes found in a colony with numerous females of the second form.

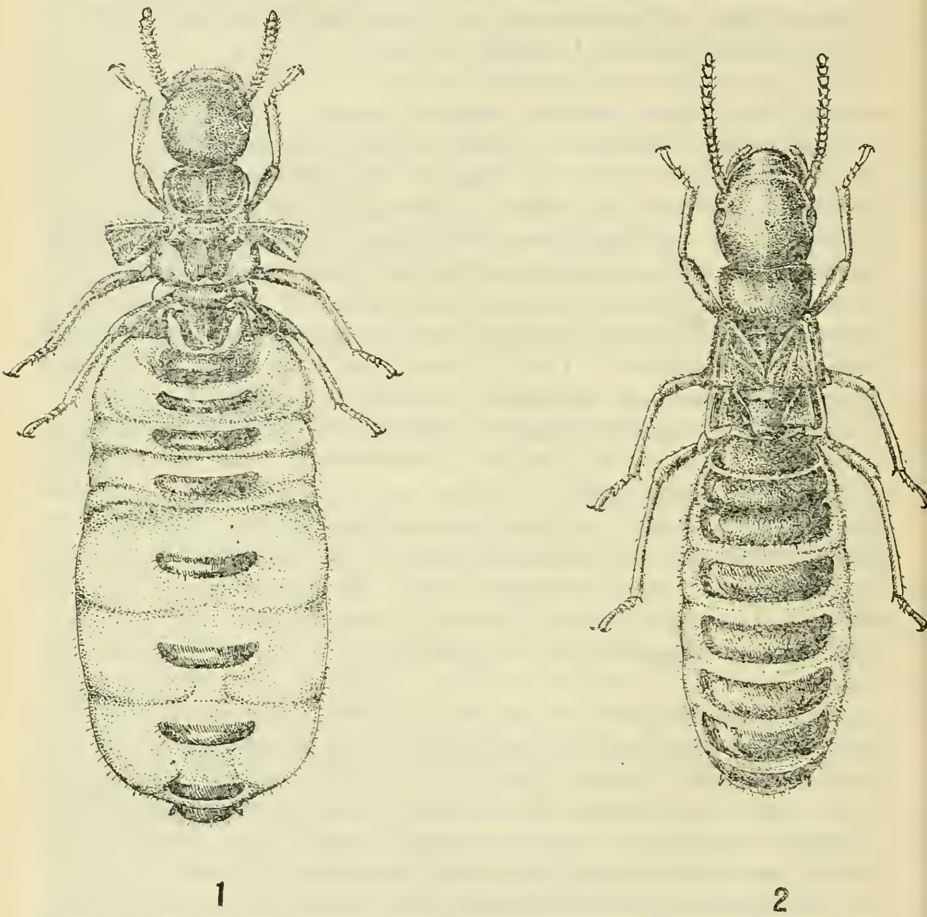

FIG. 61.—1. RETICULITERMES FLAVIPES. DORSAL VIEW OF OLD DEÄLATED FIRST FORM QUEEN. × 12. 2. DORSAL VIEW OF OLD FIRST FORM KING. × 20.

In this type of reproductive form the head, thoracic segments, and abdominal tergites and sternites are both longer and broader than in the reproductive forms that develop from nymphs of the first form. The males of the second form reproductive type have the abdomens compressed laterally, which gives the appearance of a narrow, ridged back.

This type of reproductive form breeds true to type and never produces nymphs of the normal or first form, which develop into the colonizing winged adults (Thompson and Snyder, 1919).

A rarer type of reproductive form is that of the apterous third form, sometimes known as "ergatoid" or "worker-like." (Fig. 63, 1.) Only 24 of these forms, all but one females, have been found in colonies of *Reticulitermes* in this country. They are apparently rare in species of this genus, but both males and females are fairly common in colonies of *Prorhinotermes simplex* Hagen. The colonies of *Reticulitermes* in which they have been found have in all cases except two been small. Three individuals of the species *flavipes* Kollar were found in the same colony and 17 in another in Virginia, one of *virginicus* Banks in North Carolina and one in Virginia (Snyder, 1915), one of *tibialis*

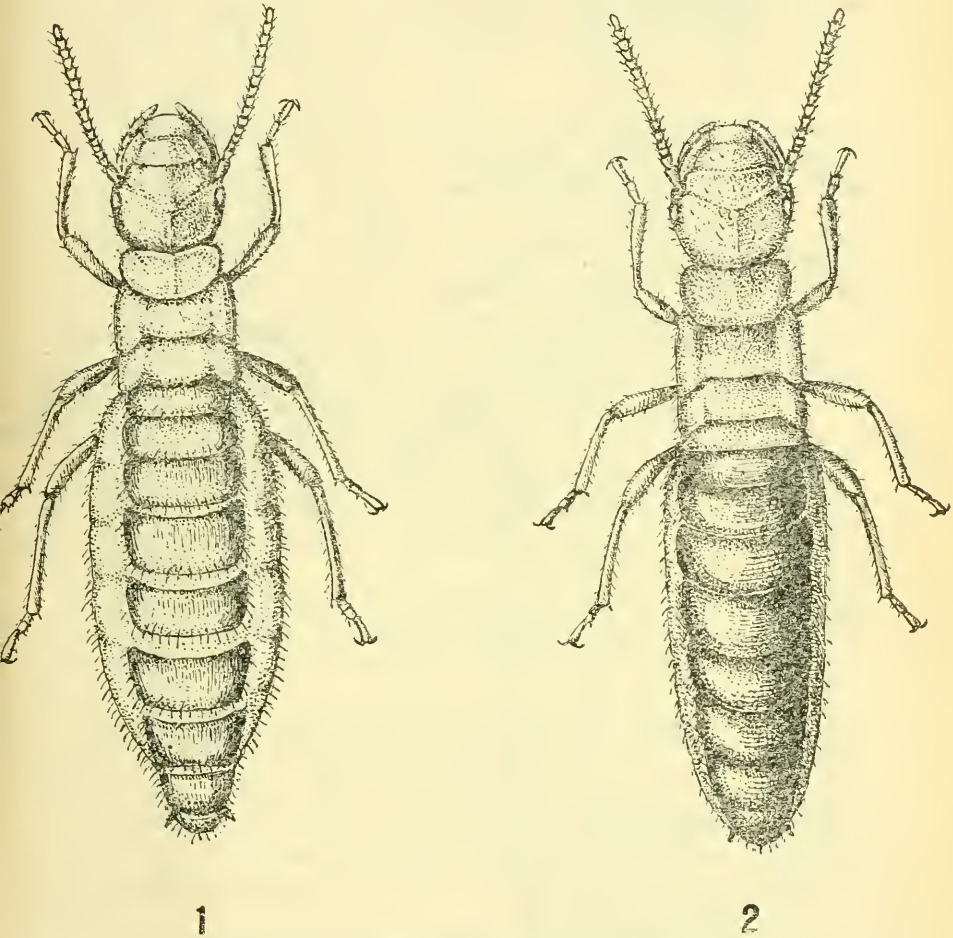

FIG. 62.—1. RETICULITERMES TIBIALIS. DORSAL VIEW OF QUEEN OF THE SECOND FORM. × 17. 2. DORSAL VIEW OF KING OF THE SECOND FORM. × 18.

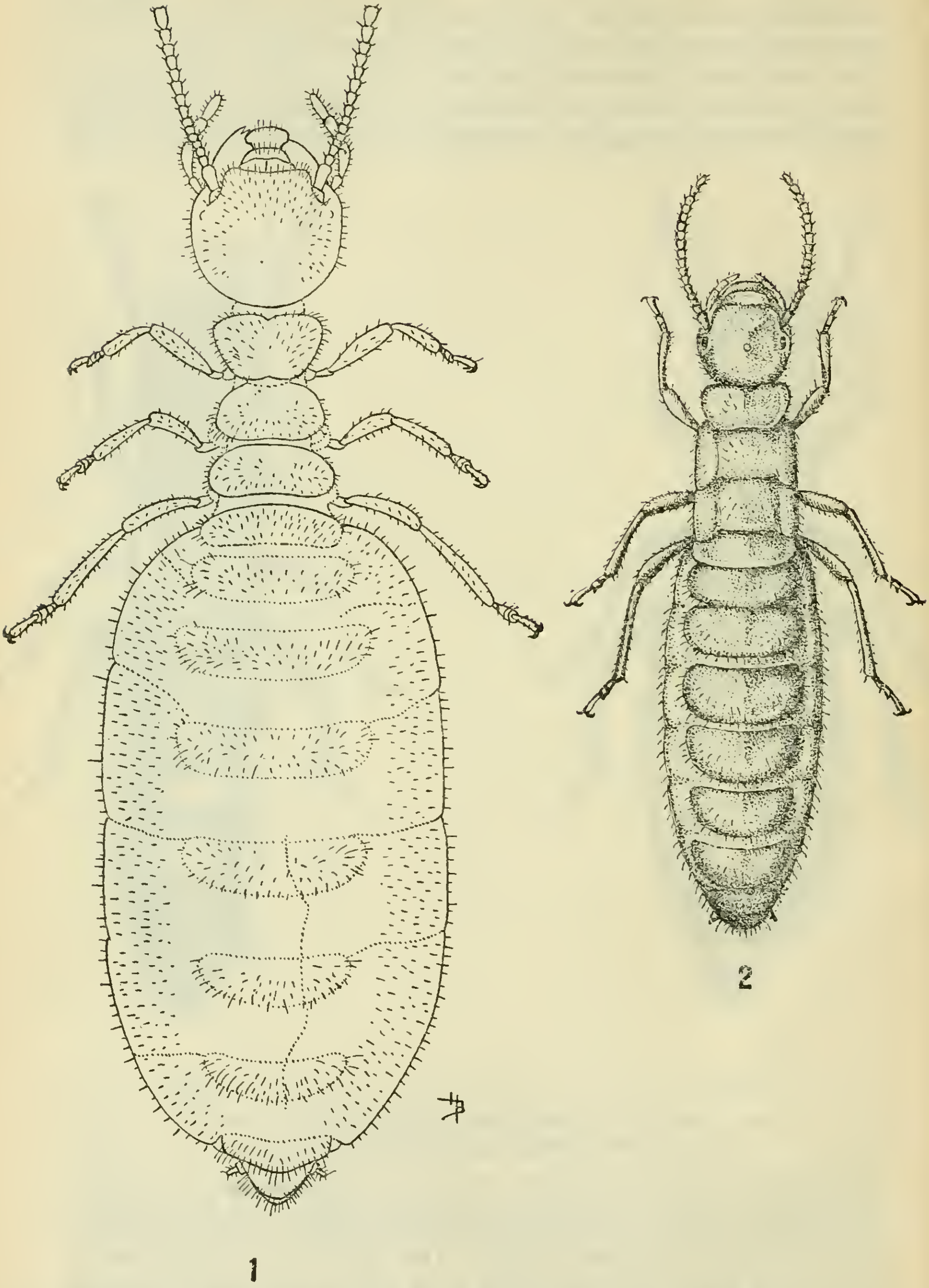

Fig. 63.—1. Reticulitermes flavipes. Dorsal view of mature apterous third form queen. × 23. 2. Reticulitermes virginicus. Dorsal view of second form queen showing distended abdomen. × 12.

Banks in Colorado by A. B. Champlain, and one young male collected in a large colony in Colorado by B. T. Harvey.

Only one male of this type has yet been found in colonies of species of *Reticulitermes.* No nymphs with long wing pads, or winged adults, have been found in colonies with this reproductive form. It probably also breeds true to type. This type of reproductive form does not leave the colony unless by subterranean tunnels. In species of *Reticulitermes* there is usually but little pigment to the body of this form; there are only traces of eyes. This is no doubt due to the subterranean mode of life of these termites.

The reproductive forms of the species of the family Kalotermitidae, including the genera *Termopsis, Kalotermes, Neotermes,* and *Cryptotermes,* which are not subterranean in habit, are always to be found in the infested wood. Queens of the first and third forms have commonly been found in colonies of species of *Termopsis*; typical queens of the second form have not been commonly found but forms with rudimentary wing pads are common (fig. 66, 1). Only one queen of the third form has as yet been found in colonies of species of *Kalotermes* (namely *jouteli* Banks). Queens of the first and second forms are not rare in species of the family Kalotermitidae.

In the genera *Termopsis* and *Kalotermes* and *Prorhinotermes* reproductive individuals of the third form have marked pigment to the body and eyes, unlike those in species of *Reticulitermes.* These differences are explained by the fact that species of these genera live above ground.

Probably only the first form adults have image perception, but the other castes (even workers and soldiers) may perceive light or direction by means of the ocelli and reduced compound eyes. (Thompson).

No types of reproductive forms of Nearctic termites ever entirely lose their power of locomotion, and there is no permanent royal cell. Their location in the colony will depend upon the season of the year and geographical locality. During warm summer weather they are usually within the more solid wood of infested trees, logs, and stumps, and, strange to say, they are often in the outer layers of wood.

In the case of the wood-boring subterranean species, the reproductive forms may be found either in the earth or in the wood. During warm weather they are usually above ground in the wood. In winter they are below the frost line in the ground in cold climates.

The burrows in the vicinity of the cell in which large mature queens are present are of larger diameter than usual; these have been used as passageways by the queen in coming up from the ground.

Although their abdomens are slightly distended, the males of the first form are very active; they are usually present in the royal cell together with the queen, but on account of their small size they frequently escape when the colony is broken into. Sometimes, when escape is shut off, the male will attempt to hide under the greater body of the female, but they usually desert their consorts at the first sign of danger.

The males of the second form are usually found associated with many females of the same form. The relative number of the sexes in a colony of *Reticulitermes virginicus* Banks in southern Florida was 32 females to 8 males; these were young reproductive forms. In a colony of *R. flavipes* Kollar in Virginia the relative number of the sexes was 28 females to 15 males; the largest female was 10 mm. in length, the average 8.2 mm.

In the United States only one male of the third form has as yet been found in colonies of species of *Reticulitermes*. In colonies of *Prorhinotermes simplex* Hagen, 8 females to 2 males occurred in a colony in southern Florida.

A large number of eggs or recently hatched young are usually present in the nest in the vicinity of the reproductive forms.

In the case of the non-wood-boring subterranean species the reproductive forms are usually deep below the surface of the ground, especially during warm, dry weather, in arid or prairie regions. Sometimes they are found at a lesser depth in the earth or under stones. In winter they are in the ground below the frost line.

Workers and soldiers.—In addition to the fertile reproductive individuals of the three different forms, there are sterile forms present in colonies of most species of termites. These sterile forms are the worker and soldier or "nasutus" castes. These castes are produced by all the reproductive forms. Workers are developed from large-headed nymphs that will not mature the sexual organs, but, unlike the bees, are of both sexes. They are large-headed and vary in shape and color. As the name implies, the workers are those individuals that make the excavations, extend the colony, and care for and protect the royal couples and young.

In the genera *Termopsis* and *Neotermes* there is no true worker caste, but there is a large-headed worker-like reproductive form present. In the genera *Kalotermes* and *Cryptotermes* there is no worker caste, the nymphs of the reproductive forms apparently attending to the duties of the workers.

The workers of the genus *Anoplotermes* are very peculiar in their appearance and method of following each other in military files. There is a characteristic musty or acrid odor which can be easily detected in colonies of *Reticulitermes*, which also have this habit, and individuals frequently can be seen to follow directly in the path taken by others; but as termites usually travel in well-worn channels this may be due to tactile sense alone.

Soldier termites are more highly specialized workers, being also developed from large-headed worker-like nymphs that will not normally mature the sexual organs, and the caste is represented by both sexes. While they are soft-bodied, the head, which is pigmented, is chitinized. The mandibles are enormously developed in some species; there is, of course, great generic variation in the size and shape of the head and mandibles of the soldiers. The soldiers are usually larger than the workers. In the genus *Termopsis* there is a great variation in the size of the soldiers; soldiers of species of *Kalotermes* also vary in size.

In the genera *Constrictotermes* and *Nasutitermes* there is no mandibulate soldier caste present, but there is a striking form with a nose-like process, beak, or nasutus—the "nasutus" caste. Liquid is exuded from this beak as a means of defense. The nasuti are usually smaller than the workers, are pigmented, and in the foraging species have long legs. Nasuti are usually constant in size.

In the genus *Anoplotermes* there is no soldier caste.

The soldiers, more highly specialized workers, are of less importance functionally than the workers—just as the anther transformed to the petal in the common pond lily (*Castalia*, species) is less important functionally than the other anthers—yet both serve a purpose. Just before the time of swarming the members of colonies become restless, and as the sexual adults emerge numerous workers and soldiers congregate on the outskirts of the colony near the exit holes with heads toward the exterior. The duty of the soldiers is apparently entirely protective, but they do not appear to be very effective, at least when the colony is opened and they are exposed to the attack of ants, etc.

"*Trophallaxis.*"—In connection with the outline of the workers' and soldiers' duties in the colony life, the following explanation is offered:

The colony life of the so-called "social insects"—that is, the ants, termites, bees, and wasps—has always excited interest. The care of the brood and the queen by the workers and the alarm manifested by the workers and soldiers of termites when the colony is broken into and the brood or queen are disturbed have called forth praise. In these prosaic days of biological *facts* much of the mystery of the complex social system of the ants and termites which led to admiration by man has had to "go by the board." Many fantastic theories have collapsed.

One of the first of these theories to go was the instinct for the care of the brood and queen.. Nils Holmgren (1909), in his studies of the anatomy of termites, devotes considerable space to the exudate tissues. All of the castes, but especially the queens, have extensive exudate tissues in the abdomen. This exudate passes through pores in the chitin to the surface. Here it is greedily licked up by other members of the colony. Holmgren evolved an "exudattheorie" to show that there is a relationship between the amount of exudate tissue and the care that a termite receives, as licking and feeding. Instead of the instinct to care for the brood, it is desire for the exudation. Holmgren concludes that he regards the exudate secretion not only (1) as the cause of feeding but (2) as the cause of caste differentiation. The work of Miss Thompson (1917) disproves Holmgren's second conclusion and also the whole subject of "manufacture" of reproductive forms through feeding by the workers.

According to Wheeler (1918) this attribute of the parental feelings of man to insects is termed "anthropomorphism" by the orthodox behaviorists. In a remarkable paper on ant larvae Wheeler suggests the term "trophallaxis;" that is, exchange of nourishment, for the coöperative relationship between adults and larvae. Wheeler further writes:

> Although considerable evidence thus points to trophallaxis as the source of the social habit in wasps, ants, and termites, it must be admitted that the phenomenon has not been observed in the social bees.
>
> * * * * * *
>
> If we confine our attention largely to the ants, I believe it can be shown that trophallaxis, originally developed as a mutual trophic relation between the mother insect and her larval brood, has expanded with the growth of the colony like an ever-widening vortex till it involves, first, all the adults as well as the brood and therefore the entire colony; second, a great number of species of alien insects that have managed to get a foothold in the nest as scavengers, praedators or parasites (symphily); third, alien social insects—i. e., other species of ants (social parasitism); fourth, alien insects that live outside the nest and are "milked" by the ants (trophobiosis); and, fifth, certain plants which are visited or sometimes partly inhabited by the ants (phytophily).

In the termite colony the workers and young nymphs of the reproductive forms may be seen carrying away eggs and young when the colony is disturbed. They solicit exudation from the anus of the queen, and also assiduously "clean"—that is, lick—over the bodies of other workers or nymphs, brushing them with the maxillary palpi.

When the colony is broken into, both workers and soldiers evidence alarm when near the reproductive forms; that is, indulge in convulsive jerky movements of the body—a method of communicating news of the danger to other members of the colony?

At the time of the emergence of the winged colonizing adults workers and soldiers congregate near the points of emergence with heads toward the exterior.

Reproductive forms of termites are often minus an antenna or leg, and nymphs of the reproductive forms sometimes have the wing pads partially bitten off, also the prothorax at the base of the lateral edges, possibly due to eagerness for exudate.

Most of these actions or facts can be explained as due to "trophallaxis." In case of the bitten wing pads on the nymphs, this may be merely incipient cannibalism.

The termite *Anoplotermes fumosus* Hagen of Mexico and Texas is usually found in the colonies of other termites, or at least closely associated with other termites in the same colony; the other termites are species of *Amitermes*. This may be termed "social parasitism," or another form of trophallaxis.

At any rate, these biological facts of behavior are just as interesting, even if due to trophallaxis, as they were when explained psychologically under the fantastical theories of the older writers, which can now be exploded and decried.

Sometimes, as abnormalities, fertile soldiers with wing pads occur in colonies. Heath (1903) records such soldiers in the species *Termopsis angusticollis* capable of laying fertile eggs, which later hatched, and the nymphs developed into the normal castes.

In the genus *Kalotermes* soldiers with wing pads have been found to occur in colonies of a number of our Nearctic species. They are not rare. It is not known whether they are normally fertile or not, but probably not.

In the genus *Reticulitermes* a rare abnormality has been found in the species *tibialis* Banks. This might be termed a half-worker, half-soldier, and was found in a colony near Missoula, Montana. The head has the characteristic pigmentation of the soldier caste and is slightly longer than the head of the worker. The mandibles are typically workerlike, but are extended. The labrum is worker-like. This individual can not be regarded as anything more than a worker of abnormal development. (Thompson and Snyder, 1919.)

Among species in the various genera of termites there apparently is a variation in the proportion of the soldier caste to the worker caste, or, where no workers occur, to the nymphs of the reproductive forms. In incipient colonies there are usually one or two soldiers to 6 to 12 workers or nymphs, so the proportionate numbers probably also vary with the age of the colony. Of course, the proportionate number of the nymphs of the reproductive forms and young would not only vary with the season of the year, but also with their incidental position (depending on the weather) when the colony was broken into. Also under the heading "workers" may be included young of the worker-soldier type; that is, either potential soldiers or workers. Under the heading "nymphs" in the family Kalotermitidae this is also the case, except in the genera *Termopsis* and *Neotermes*, where the worker-like forms without wing pads are either potential soldiers or wingless third form reproductive individuals.

In the accompanying table, except in a few cases, only a fraction of the entire colony is represented.

Proportion of soldiers to workers or nymphs of the reproductive forms or adults in colonies of Nearctic Termites.

				Date collected.	Locality.	Size of colony (estimate).	Per cent of colony collected (estimate).	Number of soldiers or nasuti caste.	Per cent soldier to worker or nymph.	Number of workers.	Number of nymphs of reproductive forms.		Number of adults of reproductive forms.	Number of young.
											With wing pads.	Without wing pads.		
Family Kalotermitidae.	Subfamily Termopsinae.	Genus *Termopsis*.	Species *angusticollis*	May 29, 1917	South Pasadena, California.	Large	Very small	8	6	......	80	39	1 deälated first form, male.	13
	Subfamily Kalotermitinae.	Genus *Kalotermes*.	Species *schwarzi*.	Mar. 20, 1917	Miami Beach, Florida.	Large	Very small	13	9	......	120		1 winged first form adult.	15
			Species *jouteli*.	Dec. 30, 1918	Miami Beach, Florida.	Fairly large	Large	39+	4	......	......	708+	1 third form, female.	38
				Jan. 1, 1919	Ragged Key No. 6, Florida.	......	Small	12	6	......	144	62	4 winged adults	......
		Genus *Neotermes*.	Species *castaneus*.	May 15, 1916	Adam Key, Florida.	Large	Small	20	14	......	57	62	......	......
		Genus *Cryptotermes*.	Species *cavifrons*.	Mar. 21, 1917	Adam Key, Florida.	Large	Small	9	2	......	404		4 pair deälated first form adults, females, with distended abdomens and 1 male.	......
				Mar. 22, 1917	Adam Key, Florida.	Large	Small	13	2	......	561		Pair deälated first form adults.	......

Family Termitidae.	Subfamily Rhinotermitinae.	Genus *Reticulitermes.*	Species *flavipes.*	Apr. 30, 1919	Falls Church, Virginia.	Not large....	Large.......	65	9	676	30	1 first form female with distended abdomen.	26
				May 4, 1919	Chain Bridge, Virginia.	Not large....	95 per cent..	25	14	178	10 11	4 winged adults, all males.	2
			Species *tibialis.*	Apr. 16, 17, 19, 1915.	Colorado Springs, Colorado.	Very large..	95 per cent..	115	2	5,463	164	1 third form male..	297
		Genus *Prorhinotermes.*	Species *simplex.*	Mar. 21, 1917	Adam Key, Florida.	Large.......	Small.......	84	15	469	89	10 third form adults.	98+ and eggs.
			Species *tubiformans.*	Sept. 29, 1917	Victoria, Texas....	(?)	(?)	5	1	294	....	....	....
	Subfamily Termitinae.	Genus *Amitermes.*	Species *wheeleri.*	May 1, 1917	Cotulla Texas.....	....	....	1	2	47	....	....	....
				May 5, 1917	Chalk Bluff, Texas	Large.......	Small.......	3	5	57	....	....	....
		Genus *Constrictermes.*	Species *cinereus.*	May 4, 1917	Laguna, Texas....	Fairly large.	Small.......	25	47	28	....	....	....
				May 5, 1917	Uvalde, Texas....	Fairly large.	Small.......	5	3	15	....	....	....
			Species *tenuirostris.*	May — ——	Catalina Springs, Arizona.	(?)	(?)	3	9	29	6	....	....

PARASITES.

FUNGI.

The species of *Reticulitermes* are infested by a parasitic fungus. It is not at all rare to find, especially in the worker caste, a narrow grayish band with black scalloped turned-up edges, usually on the dorsum of the abdomen, but sometimes present also on the ventral surface and as plates on the legs. These bands are sometimes present on the abdomen of soldiers, and may occur on the thorax and head of workers. It was first thought that these black bands might be healed-over wounds where the insects have bitten one another (pl. 16, fig. 1); later they were attributed to a bacterial or fungous disease, or to both wound and disease.

These bands occur on workers, soldiers, and second-form reproductive females of *R. flavipes* Kollar in Virginia, Maryland, the District of Columbia, and Massachusetts; *virginicus* Banks in Virginia, Maryland, and the District of Columbia; and a new species from California, in the United States. At a rough estimate, there is one diseased insect to a hundred healthy insects.

Specimens so affected were sent in April, 1915, to Dr. Roland Thaxter, of the Gray Herbarium of Harvard University, for an opinion as to whether these bands represented diseased tissue. Doctor Thaxter, after an examination of this material, stated that "the spots and bands are due to the growth of a fungus, apparently an imperfect form of a very peculiar type and not nearly related to any of the parasites of living insects which I have encountered." Doctor Thaxter requested additional living material so that data on the manner of spore discharge might be obtained, and intends to describe this form, "which seems * * * to be quite new."

Workers with similar black bands have been found in other parts of the world and in other genera; workers in a colony of *Reticulitermes lucifugus* Rossi from Sardinia, in the Mediterranean, were so diseased. They were collected by A. H. Krausse.

PROTOZOA.

Parasitic infusoria were described in *Termes* by Lespès. Termites are infested internally by protozoan parasites. Organisms infesting *Reticulitermes* (*Termes*) *flavipes* have been recorded by Leidy (1877 and 1881) and Porter (1897).

Protozoa infesting *R.* (*Termes*) *lucifugus* Rossi have been described by Grassi (1893). Kofoid and Swezy (1917) have studied and described protozoan parasites of termites.

NEMATODES.

Lespès (1856) described a nematode which he found living within the body of *Reticulitermes* (*Termes*) *lucifugus*. His description was very short and indefinite. Merrill and Ford (1916) have studied the life history of a nematode parasite (*Diplogaster aerivora* Cobb) which occurs in the head of a species of *Reticulitermes* at Manhattan, Kansas. The nematode parasite *Diplogaster aerivora* Cobb was also introduced into this termite by the same workers.

During July, August, and September, 1918, nematodes were found to be common in artificial colonies of *Reticulitermes flavipes* collected in Virginia. Dr. N. A. Cobb determined these nemas as *Rhabditis janeti* Lacazi Duthier, *Diplogaster aerivora* Cobb? or a closely related form, and an undetermined species, of which only a very young larva has been seen.

Dr. Cobb writes, in a letter dated August 7, that—

> both the *Rhabditis* and the *Diplogaster* occur in the insect. * * * Both occur in the adult stage in sick and dead insects.
>
> Both occur in a larval condition in the head of active, normal-looking insects. What part of the head I have not determined.
>
> The literature of the subject you will find in the following papers:
>
> 1. Janet, "Etudes sur les fourmis," Mem. de la Soc. Zool. de France, 1894.
> 2. de Man, Extrait des Mem. de la Soc. Zool. de France. 1. "Sur la Rhabditis Janeti Lac. Duth." 1894? 2. "Note Supplementaire Sur la Rhabditis Janeti Lac. Duth., 1894.
> 3. Merrill, Ford and Cobb, Journal of Agricultural Research, Vol. VI, No. 3.

In a letter dated August 24, Dr. Cobb wrote that—

> the second nest of white ants contained in addition to the species already noted two additional nemas:
>
> 1. *Rhabditis dolichura* Schneider.
> 2. *Diplogaster attenuatus* n. sp.
>
> This latter has been already well figured by Looss in his great work on the hookworm, but he did not attempt to identify it.
>
> Both these species are probably very common feeders on decaying organic matter in this country, though previously they have not been observed, except that I have a MS. record of *Rhabditis dolichura* from the excreta of dogs. There is, however, no published record of either of these species occurring in America. *R. dolichura* is evidently common in Europe. *D. attenuatus* was found by Looss in Egypt.

MITES.

Most of our native termites are infested externally with mites. These mites found with termites were identified by N. Banks, who states that, as usual with mites on insects, they are mostly immature.

A large greyish-brown mite found with *Termopsis angusticollis*, at Victoria, British Columbia, is a species in the genus *Parasitus*. Another mite found with this termite, at Portland, Oregon, is a "hypopus" or migratorial nymphal stage of a Tyroglyphid.

On *Reticulitermes flavipes* may be found grey mites, attached to the border of the head of workers, or attached side-ways between the workers' legs on the ventral prothorax. In the vicinity of Washington, District of Columbia, these mites include a Parasitid and a species in a genus near *Myrmonyssus*.

A species of mite in the *Antennomophorini* was found with *Prorhinotermes simplex* at Miami Beach, Florida.

On November 4, 1918, M. A. Murray found numerous mites on nymphs of *Reticulitermes virginicus* Banks in an artificial colony. This colony was maintained between thin plates of glass, separated by narrow strips of glass, the interior filled with sand and sawdust. The termites were collected at Falls Church, Virginia, on August 23, 1918.

On December 2 these nymphs were covered with mites; many of the termites had died.

According to Nathan Banks these mites were all of the immature stage (known as a hypopus) of a Tyroglyphid mite. It is not known that they feed in this stage, but attach themselves to insects for purposes of migration. Most of the mites were on the head and legs, while the abdomen would be the best place for a square meal.

INSECTS.

No insect parasites of our native termites have been found as yet.

PREDATORS.

Other than ants, many forms of insectivorous animal life prey on termites, especially at the time of the swarm, when they are attracted to the cloud of flying insects. Lizards, barnyard fowls, many varieties of wild birds (Snyder, 1916), spiders, crickets, etc., all take their toll of the numbers of swarming termites.

Among insects, predacious flies capture winged termites. On September 1, 1917, an Asilid fly (*Holocephala abdominalis* Say) was collected feeding on swarming adults of *Reticulitermes hageni* Banks in the District of Columbia. An Asilid (*Atomosia puella* Wiedermann) was captured by the writer on June 9, 1919, at Falls Church, Virginia, flying with a winged adult of *Reticulitermes virginicus* Banks shortly after this termite had swarmed.

When the termites are in their burrows in wood they are also attacked by predators. Centipedes, predacious beetle larvae, and doubtless Dipterous larvae reduce their numbers.

TERMITOPHILOUS INSECTS.

"Termitophilous" insects, "guests," or inquilines are occasionally present in the colonies of our native termites. The exact relation between these intruding insects and the termites of the colony is not known, but they are evidently tolerated by the termites. This symphily has been attributed by Wheeler (1918) to trophallaxis. A list of these inquilines has been published by Schwarz (1889 and 1895); Snyder (1915) also has notes on inquilines.

The large *Termopsis angusticollis* Hagen of the Pacific Coast region sometimes has a species of beetle (*Valgus californicus* Horn) in its colonies. These were found by the writer at Little Bear Lake, California, at an elevation of 5,000 feet. Beetles of this Scarabaeid genus are commonly found in colonies of *Reticulitermes* in eastern

United States, but the western species is rare. A Silphid inquiline (*Platycholeus leptinoides* Crotch) has been found in the nests of *Termopsis nevadensis* Hagen in California and Oregon.

In the eastern United States both Staphylinid and Pselaphid beetles occur in colonies of the species of *Reticulitermes*. *Trichopsenius depressus* LeConte and *Microcyptus testaceus* LeConte were found by H. G. Hubbard living together with *R. flavipes* Kollar in Florida; the former species of beetle was found by the writer with *flavipes* in a chestnut telephone pole near Bloomingdale, in the vicinity of Savannah, Georgia, on October 26, 1915; and in November, 1917, again in a chestnut telephone pole near Savannah by E. B. Griffen, of the American Telephone and Telegraph Company. *Trichopsenius depressus*, so far as is known, has only been found associated with reproductive forms of termites. Hubbard found this beetle with second form reproductive types near Crescent City, Florida, April 20, 1882. The writer's specimens were found with 5 females and 7 males of the second form, and Griffen's specimens were found with a large queen of the first form.

Staphylinid beetles of the genus *Philotermes* also occur with species of *Reticulitermes;* the species *P. pilosus* Kraätz, *pennsylvanicus* Kraätz, and *fuchsii* Kraätz all have been found in colonies of *flavipes* in eastern United States. *Tachyporus jocosus* Say and *Homalota*, species are recorded from colonies of *flavipes* by King (1897).

Of the *Pselaphidae*, *Tmesiphorus carinatus* Say was found by the writer in Virginia with *R. flavipes* and *Batrisus*[1] *virginiae* Casey with colonies of *R. virginicus* Banks.

The Scarabaeid beetles *Homovalgus squamiger* Beauvois and *Valgus canaliculatus* Fabricius are commonly found associated with species of *Reticulitermes* in eastern United States.

H. G. Hubbard found insects thought to be peculiar wingless psocids, which resemble young termites, in a colony of *R. flavipes* near Haw Creek, Florida, on March 26, 1895. On April 10, 1918, the writer found a colony of *Prorhinotermes simplex* Hagen in a decayed red mangrove log in a swamp along Biscayne Bay opposite Miami, Florida. In this colony numerous white, very active insects, somewhat resembling young termites were found; they were thought to be the same as the "wingless psocids" previously found by Hubbard (Snyder, 1915). These insects were found in several other colonies of this termite, were fairly common, and were also in portions of the logs where termites were not present. They have proven to be a new species of *Zorotypus*, namely *hubbardi*, (Caudell, 1918) in Silvestri's new order *Zoraptera* (Silvestri, 1913).

A Nitidulid beetle, *Amphotis ulkei* LeConte, was found by the writer in a colony of termites (*R. flavipes*) on July 9, 1918, at Falls Church, Virginia. This beetle has been found in colonies of ants and is a myrmecophile. It has never before been recorded as occurring in termite colonies.

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[1] Now *Batrisodes*.

A peculiar Neuropterous larva was found in a colony of *flavipes* in a decaying branch lying on the ground near a stream at Falls Church, Virginia, on July 18. This was a fully developed first form larva of *Mantispa*, according to Dr. A. Böving, and is probably predaceous. It appears as if it might be luminous at the body segments. After placing it in alcohol it changed to a second form larva.

On April 29, 1918, a colony of *Prorhinotermes simplex* was collected in a decaying red mangrove log at Miami Beach, Florida, and placed in rearing at Falls Church, Virginia. Two termitophilous adult Staphylinid beetles (*Microcyptus testaceus* LeConte) were found in this colony on July 24.

Other adults of this termitophilous beetle were found in colonies of *Prorhinotermes simplex* on February 28, 1919, in decaying red mangrove logs in a swamp at Miami Beach.

On February 24, 1919, at Princeton (near Homestead), Florida, nymphs and a deälated pigmented adult of *Zorotypus* were again found under moist bark on the underside of a decaying Cuban pine log. This log was infested with the termite *Prorhinotermes simplex*. In this pineland other nymphs of *Zorotypus* were found.

At Miami Beach, Florida, on February 27, nymphs and deälated pigmented adults of *Zorotypus* were found under bark on dead standing white and red mangrove trees and on decaying logs in a swamp with this same termite. Some colonies had reproductive forms (large, distended third form queens) of the termite present.

Later at Ortega, Florida, near Jacksonville, on March 5, nymphs of *Zorotypus* were found under bark on a log where no termites were present. It is concluded therefore that this peculiar insect is not necessarily a termitophile but requires similar conditions of moisture to the termites *Prorhinotermes* and *Reticulitermes*. Not more than two deälated adults have been found in the same colony.

Association with Ants.

While termites and ants are commonly to be found inhabiting the same log or stump, yet ants are the worst enemies of termites. Ordinarily the relations between termites and ants are peaceful, even when they occupy contiguous galleries or actually intermingle. The ants seem to be indifferent to the presence of the termites until man breaks into the nests, when the ants soon attack the termites. Wheeler (1913) has discussed the relations of ants to termites.

Species of *Cremastogaster*, *Camponotus*, and *Formica* are common associates of termites in eastern United States and are among the worst enemies of the soft-bodied termites. Living termites have been found in the mounds of *Formica* in Pennsylvania and Virginia.

The argentine ant (*Iridomyrmex humilis*) is a great enemy of termites in New Orleans, Louisiana, according to Father A. Biever.

At the time of the annual swarm, ants kill and carry away many winged termites.

Beebe (1918) states that termites are immune to attack by the army ants of the Tropics.

BIOLOGICAL NOTES ON THE DIFFERENT SPECIES.

Family KALOTERMITIDAE Banks.

Subfamily TERMOPSINAE Holmgren.

Genus TERMOPSIS Heer.

The genus *Termopsis* Heer includes species among the most primitive and the largest of our North American termites. But although large, they are among the least destructive of our native species. There are but few records that these termites have injured either the woodwork of buildings, healthy living trees and other growing vegetation.

M. W. Gorman, Curator of the Forestry Building, Portland, Oregon, wrote on April 11, 1918, that termites had damaged the beams in that building. The insects were not active after the winter till the first week in April; they swarm in July or early August in great numbers. The termite was *T. angusticollis*.

None of the species are subterranean in habit, living in the (usually decaying) wood of logs, stumps, and dead portions of living trees, usually in conifers, since these predominate in the regions where most species of *Termopsis* occur, but the wood of deciduous trees is also infested. The burrows usually follow the grain, except in badly disintegrated wood and the wood is "honeycombed." (Pl. 16, fig. 2.) The pellets of excrement are more or less regularly impressed (pl. 9), and are often found in moist matted lumps in old burrows or they are expelled from the nests and fall to the ground.

Old, long-established colonies contain several thousand individuals. Species of *Reticulitermes* sometimes inhabit the same tree or log as *Termopsis*. Moisture is necessary for both these genera of termites.

All of our native species of *Termopsis* swarm at night and are strong fliers.

The castes in the genus *Termopsis* are soldier, a worker-like reproductive nymph with greyish-brown pigmentation, and the reproductive individuals of the three forms. There is no true worker caste, but the duties of the workers are often performed by the nymphs of the fertile third-form adults—large, worker-like, greyish-brown forms, with no wing pads.

The soldiers are large-mandibled and of a very formidable appearance. They vary greatly in size in the colony.

TERMOPSIS ANGUSTICOLLIS Hagen and T. NEVADENSIS Hagen.

For taxonomy, see pp. 11–15.

Termopsis angusticollis Hagen and the nearly related *nevadensis* Hagen reach the farthest north of any North American termites and also occur at great altitudes in the mountains of the Pacific Coast region. These two species are very closely related and have practically the same distribution and habits; they were not distinguished by the early writers, although, as early as 1874, Hagen separated *nevadensis* as a variety consisting of the small, dark forms from Nevada.

Baron Osten-Sacken (1877) noted the occurrence of termites in California, stating:

> *Termopsis angusticollis* (or *nevadensis* Hagen) was frequently observed by me in dead trunks and branches of *Quercus agrifolia*, near Santa Barbara, in February. The specimens * * * were taken from a small trunk or root, completely riddled by them.

Heath (1903 and 1907) has described in detail the habits of *Termopsis angusticollis* in California.

The colonies of these termites are to be found in the decaying wood of logs and stumps and are often of large size. In the forests they cause the rapid disintegration of such wood into humus.

During the final molt the females of fertile nymphs normally lose the genital appendices. In egg-laying queens of the third form of *Termopsis nevadensis* (with no indication of wing pads) genital appendices were noted as present, though they are absent in the winged queens of the first form. The castes of *Termopsis,* as do all termites, pass through similar quiescent stages noted (Snyder, 1915) in the metamorphosis of species of *Reticulitermes.*

On May 7 to 14, 1913, observations were made of the molting of nymphs of the first form of *nevadensis.* It was found that the skin is shed in 15 minutes; the skin breaks along the median dorsal line of the thorax. Two and one-half to three and one-half hours were required for the wings to expand. At the end of 12 hours the castaneous pigmentation was attained, but the mature pigmentation is not acquired for several days. The insects are not ready for flight for some time (a week or 10 days) after the wings have been expanded and the mature pigmentation attained. The specimens on which these notes were made were reared in cages at Falls Church, Virginia, but the colony was collected by George Hofer, on April 18, 1913, in an old pine stump at Rogue River, Oregon.

SWARMING.

Termopsis angusticollis and *nevadensis* are nocturnal swarming species; the winged adults are attracted to lights. Apparently these strong flying species swarm over long periods, either in the late spring or fall. Osten-Sacken (1877) writes:

> I saw this large species *flying* at Clark's Ranch, Mariposa County, June 3–4; in Yosemite a few days later (altitude of the valley 4,000 feet). I suppose, therefore, that lower in the valley they fly much earlier. I saw them again about Lake Tahoe (6,200 feet altitude), July 18. They were very numerous in the air about sunset. I observed a very large stump of *Pinus ponderosa* covered with specimens, which, after alighting, got rid of their wings and were running about on the horizontal surface of the trunk, examining the crevices, but not attempting to descend into them. Torn-off wings were lying in numbers on the trunk. On the previous day (July 17) I had seen the same species flying about at Summit, Sierra Nevada, altitude 7,042 feet. I observed a pine trunk out of which they were emerging—a proof that they actually live and breed at that altitude. July 22 the same were flying about Webber Lake 7,000 feet altitude. I observed a couple of blue birds which had their nest on the veranda and fed their young with these termites.

Winged adults of *angusticollis* in the United States National Museum which have been collected while flying bear the following labels: Shawnigan, Vancouver Island, British Columbia, "L, 1.9," H. G. Dyar; Victoria, Vancouver Island, British Columbia, 2/IX, 4/IX, and 16/IX, 1917, W. B. Anderson; Cottage Grove, Oregon, September, A. P. Morse. B. T. Harvey collected adults ready to swarm in a stump at Ashland, Oregon, August 28, 1913. H. G. Hubbard collected adults flying at Lake Tahoe, California, "7/8, 1891."

Mrs. M. A. Knickerbocker, in a letter to the Bureau of Entomology, stated that in October, 1903, at San Francisco, California:

> the air was full of them (*Termopsis angusticollis* or *nevadensis*)—winged adults. They came in the open windows in the evening, getting into our hair and ears. Next day they were gone, but wingless ones were found and also wings.

A. E. Bush collected winged adults of *angusticollis* on November 16, 1881, September 28, 1891, and October 5, 1891, at San Jose, California.

The writer collected winged, maturely pigmented adults ready to swarm in a stump, Little Bear Lake, San Bernardino Mountains, California, elevation 5,000 feet, June 1, 1917. A large first form queen of *T. angusticollis* was also found in a near-by colony (fig. 65); young were present.

Other winged adults in the United States National Museum bear the labels: Los Angeles, California., August; San Gabriel Mountains, California, elevation 3,000 feet, October 9, 1908, F. Grinnell.

At Ashland, Oregon, at an elevation of 3,500 feet, H. G. Champion found a colony of *angusticollis* or *nevadensis* in which the colonizing adults were expanding the wings and attaining mature pigmentation on May 10, 1915. There were also mature nymphs, nymphs in and after the quiescent stages, and soldiers in this colony. On May 11, in a valley at an elevation of 1,900 feet, adults were seen swarming from a colony.

At Waldo, Oregon, near the coast, adults of *Termopsis* were collected flying on September 14, 1916, by J. E. Patterson. Fifty to sixty adults were flying in a swarm at 6 p. m. around an old pine stump.

At Ashland, Oregon, in 1917, J. E. Patterson collected adults of *Termopsis* flying at lights on June 3 and 8, at about 8 p. m.

On June 26, 1917, J. M. Miller collected a *Termopsis* adult flying at dusk at Ashland, Oregon. On July 2, 1917, the writer collected an adult of *T. nevadensis* Hagen flying at dusk at Ashland, Oregon.

FOUNDATION OF NEW COLONIES.

On July 3 young parent adults of *nevadensis* were found in cells in the sapwood of dead pine trees and stumps; their cast wings were nearby and a few eggs were present (fig. 64). There must be a very irregular emergence of these winged adults.

On July 6, 1918, J. E. Patterson found a pair of deälated young parent adults of *T. nevadensis* in a burrow in the sapwood of a small dead fir tree (*Abies concolor*) in Yosemite Valley, California. On July 7, at Little Yosemite, Yosemite Park, Patterson collected similar adults in the stump of a pine tree cut and treated for bark beetles in May, 1918.

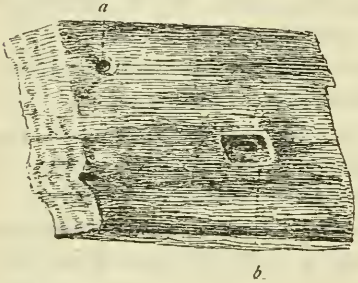

FIG. 64.—TERMOPSIS NEVADENSIS. ROYAL CELLS, OR INCIPIENT COLONIES FOUNDED BY FIRST FORM COLONIZING PARENT ADULTS IN THE SAPWOOD UNDER THE BARK OF A DEAD YELLOW PINE TREE, JULY 3, 1917, ASHLAND, OREGON; NAT. SIZE. *a*. BEGINNING OF ROYAL CELL EXCAVATED BY YOUNG PARENT ADULTS. *b*. ROYAL CELL CONTAINING A PAIR OF YOUNG PARENT ADULTS, *i. e.*, AN INCIPIENT COLONY.

Near Lake Tenaya, Yosemite Park, on August 11, 1918, another pair of young parent adults of *T. nevadensis* were taken by Patterson from a small tree killed by *Dendroctonus monticolae* in 1917.

Termopsis nevadensis Hagen swarms at practically the same time as *T. angusticollis* Hagen. Winged adults of *nevadensis* in the United States National Museum, collected flying, bear these labels: Departure Bay, Vancouver Island, British Columbia, July 14, 1913, E. M. Walker; Royal Oak, Vancouver Island, British Columbia, 1913, IX, 1917, and 25, IX, 1917, E. M. Walker; Hood River, Oregon, 19/5, H. G. Hubbard; Dunsmuir, California, VII, 20, Dyar and Caudell; Redwood Creek, Humboldt County, California, 9, VI, H. S. Barber; El Dorado County, California, July 12, E. O. Essig; Lake Tahoe, California, 11/7, Hubbard and Schwarz; San Jose, California, January, 1891, A. E. Bush; Mount Whitney, California, VII, 1904, United States Fish Commission; Los Angeles, California, June, D. Coquillett.

On July 7, 1916, seven miles north of Missoula, Montana, on Rattlesnake Creek, winged adults of *nevadensis* were taken at a light on the wing in the woods between 9.30 and 10 o'clock at night. Four specimens were collected by B. T. Harvey and Josef Brunner. There had been showers in afternoon and evening, sultry cloudy weather, temperature 68° F.

Josef Brunner later collected winged adults of this species at Clinton, about 15 miles east of Missoula, Montana, at 10.30 p. m., August 1, 1916, and at Orchard Homes, about 4 miles from Missoula, Montana, in the Missoula River bottom on August 24. Brunner states that there are no conifers except *Juniperus* within 4 or 5 miles of this locality. All acted very excitedly on account of the light, alighting on a tree and running around, then again fluttering around the light. Light appears to make termites even more excitable than moths.

Brunner writes:

> By June 15, at Missoula, Mont., the pollen of yellow pine was falling like clouds of dust. This marked the first appearance of termites flying and attracted to lights. As specimens of termites were collected or observed at lights regularly from that time on until August 24, it appears that their flying period is so extended that to attempt to correlate it with a certain stage of plant life is without value. While the season of flight extended over a long period, there were but few nights when the insects actually did fly. These were the few really warm nights during the season. In warmer seasons, when the ground everywhere is warmed up more uniformly, it is very likely that the flying period is cut short (?). At Orchard Homes the country looks as if it should be about the warmest around about here. In reality it was the coldest last season, and the sandy soil did not seem to warm up during the entire season.

After the "swarm" or the emergence of large numbers from the parent colony in the late spring or autumn, just at dusk, unlike species of *Reticulitermes,* these termites do not fall to the ground after a short flight, shed their wings, and begin excavating in the ground under decaying wood. These insects fly about seeking holes, loose bark, or decayed places in trees. Then they shed their wings and begin to burrow into the decayed area. The wingless adults are very active and are able to jump up into the air by peculiar jerky movements.

Three types of reproductive forms have been found in colonies of *Termopsis angusticollis* Hagen and *nevadensis* Hagen—the normal or first form with stubs of wings (fig. 65), the second form with rudimentary or short wing pads, and that of the third form with no wing pads (fig. 66, 2). In either type the queen is active and the abdomen is not remarkably distended. Indeed, from the specimens so far collected, the queens of *Termopsis* are relatively small. The males flip themselves up in the air and often fall over backwards in attempting to escape. As in *Reticulitermes,* there may be several of the third form reproductive adults in the same colony. No wing pads are present on these forms, which develop shortly after the loss of the reproductive forms of the normal type. They have straw-colored pigmentation, but this is not different from that of the nymphs of the reproductive forms, or worker-like individuals. There is pigment in the eyes, which, however, are evidently functionless.

Two individuals with a slightly more characteristic pigmentation were found in a colony by the writer in the Big Basin in the Santa Cruz Mountains, California, on June 13, 1917. They had only rudimentary wing pads and pigment to the traces of eyes, but are undoubtedly reproductive forms (fig. 66, 1). Normal second forms with longer wing pads are apparently not so common.

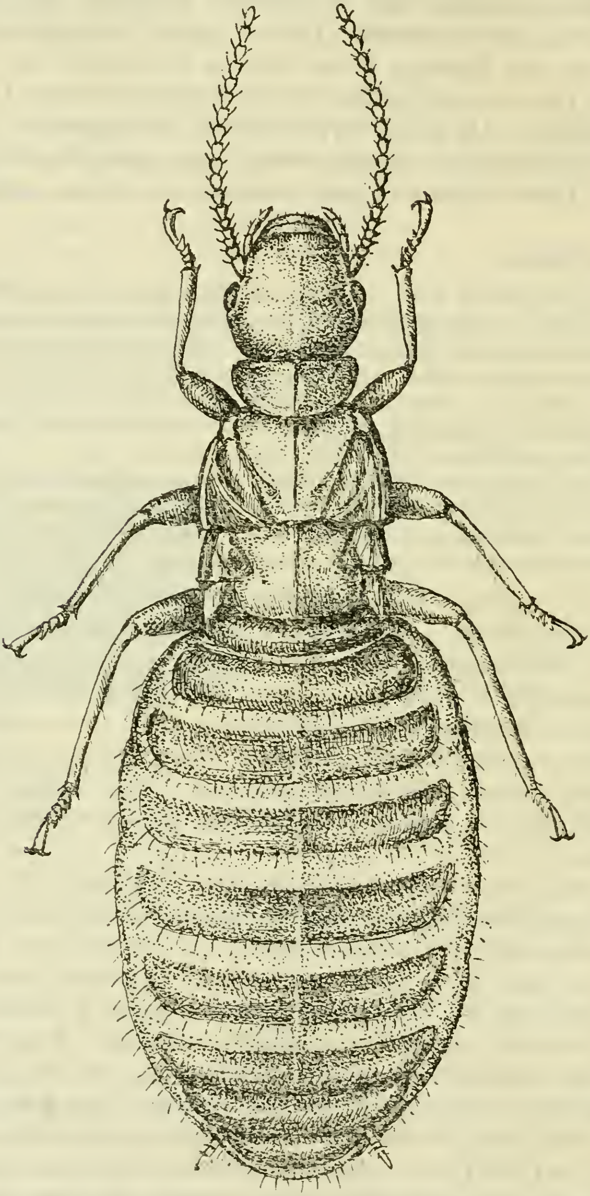

FIG. 65.—TERMOPSIS ANGUSTICOLLIS. DORSAL VIEW OF ENLARGED QUEEN OF THE FIRST FORM. (NOTE RELATIVELY SMALL SIZE OF THE QUEEN OF THIS LARGE TERMITE.) × 9.

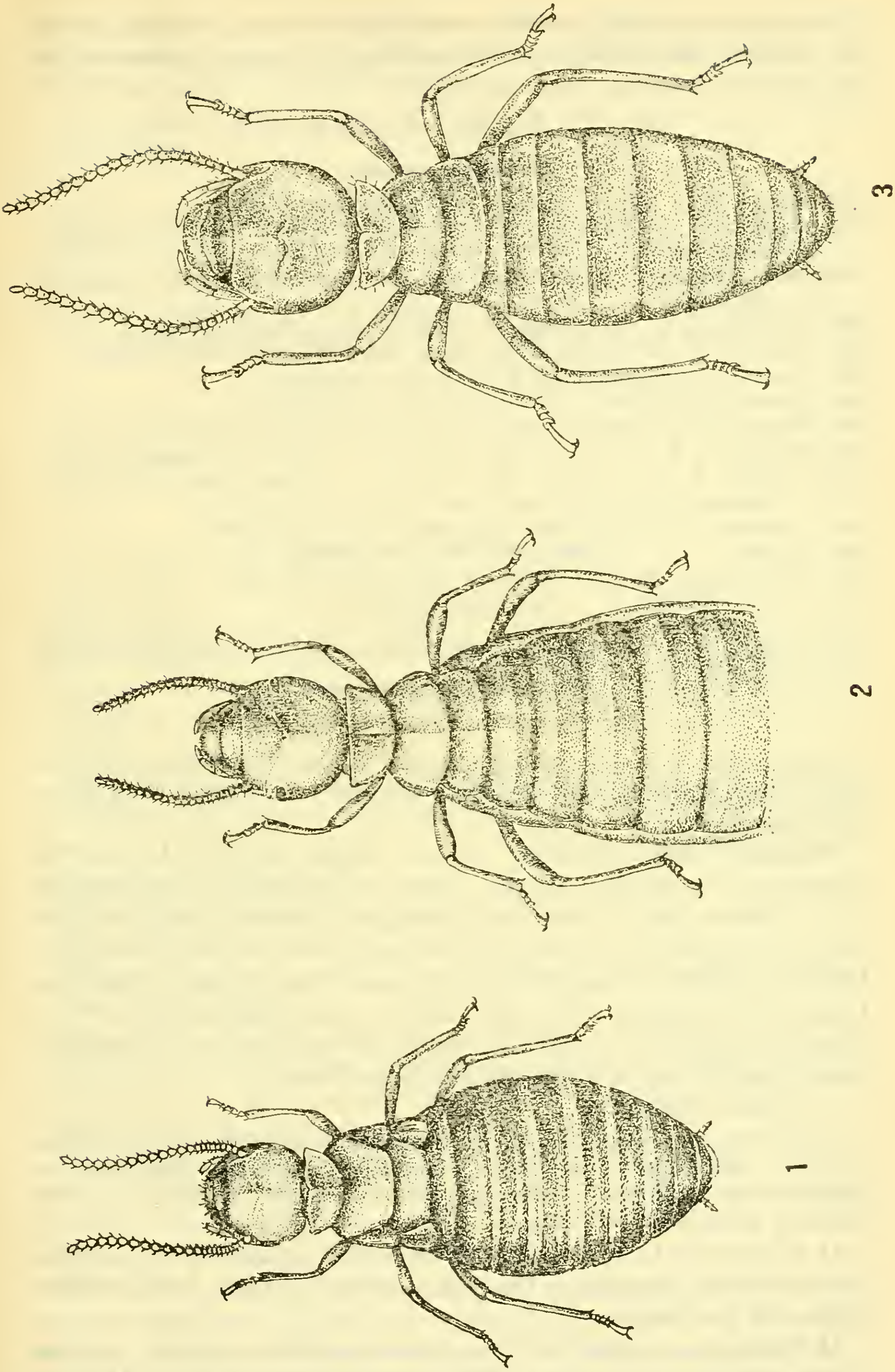

Fig. 66.—Termopsis angusticollis. Dorsal view of male of the second form, showing rudimentary wing pads. × 10. 2. Termopsis nevadensis. Dorsal view of a portion of the enlarged abdomen of an apterous third form queen. × 10. 3. Termopsis angusticollis. Dorsal view of nymph of a reproductive form. × 15.

The eggs are slightly reniform and fully 1½ mm. in length; there are parallel (horizontal) surface markings;[1] on eggs preserved in alcohol and somewhat shrivelled.

References to Biological or Economic Literature.

Termopsis angusticollis.

1860. Hagen, H. A. Linnaea Entom., vol. 14 (Nachtrag), p. 101.
1874. Hagen, H. A. (Hayden, F. V.) Ann. Rept. U. S. Geol. Surv. Terr. for 1873, pp. 571–606.
1877. Osten-Sacken, C. R. Proc. Bost. Soc. Nat. Hist., vol. 19, pp. 72–3, for Jan. 3, 1877, June.
1883. Packard, A. S. Third Rept. U. S. Entom. Com., Wash., pp. 326–29.
1895. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 3, No. 2, p. 73–78, January 8.
1903. Heath, H. Biol. Bull., vol. 4, No. 2, pp. 47–63, Jan.
1907. Heath, H. Biol. Bull., vol. 13, No. 3, pp. 161–4, Aug.
1908. Kellogg, V. American Insects, chap. 7, pp. 99–109, New York.
1915. Snyder, T. E. Bur. Ent. Bull. 94, pt. 2, U. S. Dept. Agric., pp. 13–85, Feb.
1916*a*. Snyder, T. E. Farmers' Bull. No. 759, U. S. Dept. Agric., Oct. 9, p. 8. footnote.
1918. Comstock, J. M. The Wings of Insects, chap. 8, pp. 132–144.
1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, p. 379–398.

Termopsis navadensis.

1874. Hagen, H. A. (Hayden, F. V.) Ann. Rept. U. S. Geol. Surv. Terr. for 1873, pp. 571–606.

TERMOPSIS LATICEPS Banks.

For taxonomy see pp. 15–16.

This species was described by Banks (1906), the type specimens being from Florence and Douglas, Arizona. It occurs in Arizona and New Mexico.

Townsend (1893) published a short paper, entitled: A Note on *Termopsis angusticollis* Hagen, giving descriptions, measurements of the soldiers and nymphs, and biological notes on a large termite found on February 11, 1893, in galleries in dead or nearly dead cottonwood trees (*Populus fremontii*), near Las Cruces, Dona Ana County, New Mexico. The specimens had been determined by C. V. Riley as *Termopsis angusticollis* Hagen, but according to Townsend's measurements undoubtedly are *T. laticeps* Banks.

Townsend writes:

> A row of large cottonwoods along an acequia showed an unhealthy condition and was cut down. Most of these were found to be mined by the termites. They seemed to prefer the more moist parts of the tree, either live wood or wood moistened by the proximity of the water in the acequia.

H. G. Hubbard, on May 22, 1897, collected nymphs of this termite in the Galiuro Mountains, Graham County, Arizona, from "hollow in base of a willow tree."

M. Chrisman, on July 3, 1914, collected soldiers, nymphs, and immature winged sexual adults of *T. laticeps* Banks in Edgar Canyon,

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[1] These spiral markings may be only outlines of the egg follicle cells since fresh eggs do not have these markings.

Santa Catalina Mountains, Arizona, in alder. The tree was a large, live tree, with a dead part at the butt; a mere shell of dead part was left, being eaten out by the termites.

The habits of this species are similar to that of *Termopsis angusticollis* Hagen.

SWARMING.

This termite swarms in June or July; winged adults have been collected in June and July at Garcia and during July at Palmerlee, Arizona (C. R. Biederman); in the Santa Rita Mountains, Arizona, elevation 5,000 to 8,000 feet, July (F. H. Snow); and in the Santa Catalina Mountains, Arizona, July 8 to 20 (Lutz and Rehn).

Reference to Biological or Economic Literature.

1893. Townsend, C. H. T. Zoe, vol. 4, No. 2, July 22. (*Termopsis angusticollis* Hagen).

Subfamily Kalotermitinae Holmgren.

Genus KALOTERMES Hagen.

The species of the genus *Kalotermes* are not subterranean and are able to bore through hard, dry wood. Instead of following the grain in their burrowing, they excavate longitudinal oval chambers, interconnected by narrow passageways. Their dry, impressed pellets of excrement (pl. 10) sometimes pack these chambers or are expelled and fall to the ground.

Colonies are found in dead trees, logs, dead branches, and stumps. Sometimes two species will live in the same tree, log, or branch. Species of *Kalotermes* are also found associated with species of *Neotermes* and *Cryptotermes*.

Often the colonies are of very large size and the tree or log is completely riddled by burrows.

Moisture does not seem to be so necessary, since *Kalotermes* can survive in dry wood.

The species of *Kalotermes* swarm at night. After the swarm the winged insects settle upon tree trunks and logs and either before or just after shedding the wings they begin to burrow directly into the wood (pl. 17), if under loose bark, or enter crevices.

Like the species of *Termopsis*, the species of *Kalotermes*, *Neotermes*, and *Cryptotermes*, which are not subterranean, infest wood directly through holes, the burrows of other insects, decayed areas in trees, and under loose bark.

In Florida, on the offshore coral reefs or keys, no species of the subterranean genus *Reticulitermes* were found; only species of *Kalotermes, Neotermes, Cryptotermes,* and *Prorhinotermes*. Species of *Kalotermes, Neotermes,* and *Cryptotermes* were common both on these keys and on the mainland, especially near the sea coast. In the dense jungle of the wooded "hammocks" where there is a deep, damp, rich humus, species of *Reticulitermes* are present, with the *Kalotermes*.

These "hammocks," or islands, covered with jungles of deciduous or broad-leaved trees, in the Lower Everglades, have been described by Small (1916), Simpson (1916), Jennings (1916), and Safford (1919). They are located on the map of the southern extremity of Florida (pl. 18), loaned by Dr. W. E. Safford, of the Bureau of Plant Industry. Some of the Upper Keys or offshore coral reefs or islands in Dade County were also explored for termites, especially Adam Key, about 27 miles south of Miami.

There is no true worker caste, nor even worker-like reproductive nymphs, as in *Termopsis*.

In species of *Kalotermes*, as in case of *Reticulitermes*, there are three types of reproductive forms—namely, the normal, developed from winged adults, first form; the second form with wing pads; and the wingless, nymph-like or apterous type, the third form. Queens of the first, second, and third forms have been found in the United States.

The species of *Kalotermes* are of southern occurrence and are not found farther north than Savannah, Georgia, in the eastern United States, or the vicinity of San Francisco, California, on the Pacific coast.

The species of *Kalotermes* are especially destructive to the interior woodwork and furniture of buildings. The wood of both coniferous and deciduous trees is attacked. In the Gulf States and in California the species of this genus are destructive to the wood of telephone and telegraph poles. They not only damage the wood near the base of the pole but attack the dry wood high up in the pole, even in southern California, infesting the crossarms and insulator pegs. Such damage is common in the vicinity of San Diego.

The presence of the species of *Kalotermes* in wood is not easily detected. There are no galleries opening to the exterior, since these termites do not live in the ground. Their presence in wood may sometimes be detected by the impressed pellets of excreted, partially digested wood expelled from their galleries.

KALOTERMES OCCIDENTIS Walker.

For taxonomy see pp. 18–20.

This interesting termite was described from the soldier caste alone, Hagen (1858) having considered it as belonging to the genus *Termopsis?* It is the largest of our native species of *Kalotermes*, and all the soldiers the writer has seen have vestigial wing pads. These wing pads occur in other species of *Kalotermes*, but, on account of the large size of *occidentis*, they are more prominent. The wing venation is evident on the wing buds. Holmgren (1911) established a new genus (*Pterotermes*) for this termite.

K. occidentis occurs in Lower California and Arizona. Mr. Banks is not certain whether the winged adults collected in Arizona are of this species, although they agree in size. If they are not *occidentis*, then they represent a new species.

This termite swarms in Arizona in August: Coyote Mountains, August 4 to 7, and Baboquivari Mountains, August 7 to 9, 1917, Lutz and Rehn.

George Hofer found young parent adults in an incipient colony in the sapwood of a dead Palo Verde tree in Sabino Canyon, Santa Catalina Mountains, Arizona, on January 7, 1917. Only six young were in this colony.

Some of the nymphs of the reproductive forms have the (short) wing pads mutilated; that is, probably partially bitten (at the ends).

KALOTERMES MARGINIPENNIS Latreille.

For taxonomy see pp. 20–22.

Latreille (1833) described this termite (*Termès marginipenne*) from types collected in Mexico. It is a native of Mexico and Central America. In the United States *K. marginipennis* occurs in southwestern Texas, southern Georgia, and probably northern Florida.

This termite occurs as far north as the vicinity of Savannah, Georgia. It is injurious to the wood of telephone and telegraph poles in Georgia and Texas, working not only in the wood near the base, but also in the dry, hard wood high up in the poles. It is also injurious to the woodwork of buildings.

In the forest, colonies occur in dead trees, logs, and dead branches. This species is common in Texas, from Brownsville, Los Borregos, Las Palmas, Point Isabel, in Cameron County; San Diego, Duval County; Corpus Christi, Nueces County; Victoria, Victoria County; San Antonio, Bexar County; Brazos County; Uvalde, Uvalde County. In Georgia it occurs at Albany, Dougherty County, and in the vicinity of Savannah in Chatham County—Bloomingdale and Pooler. In Florida, Hubbard collected this termite in a mangrove stump on Mangrove Island, Indian River, April 6, 1880.

SWARMING.

K. marginipennis swarms at night. E. A. Schwarz states (1896) that "A few winged specimens of this common Mexican species were attracted by light in houses in San Diego (Texas) after a rain on May 21, and some other individuals deprived of wings were found running about during subsequent days." Winged adults have been collected when attracted to lights as follows: Brownsville, Texas, June 20, 1895 (C. H. T. Townsend); June 5, 1904 (Barber); San Diego, Texas, May 18 (Schwarz); Victoria, Texas, August 19, 1902, September 1, 1902, September 5, 1902 (W. E. Hinds); May 26, 1913 (Coad); Albany, Georgia, May 15, 1916 (Pierce). On May 19, 1916, the writer found winged, pigmented adults in a cypress telephone pole near Pooler, Georgia. On March 13, 1917, D. C. Parman found adults of this species with wings but not pigmented in a mesquite log at Uvalde, Texas. On April 24, 1917, the writer found at Brownsville, Texas, winged adults that were maturely pigmented and ready to swarm in stumps.

On April 22, 1917, the writer found colonies of this species at Point Isabel, Texas, in logs of wood sunken in sand a little way back from the beach; probably originally driftwood logs. A young first form queen, with slightly distended abdomen and approximately 9 mm. in length, with numerous eggs, was found in one of these logs.

The eggs are white, reniform in shape, and nearly 1½ mm. in length.

K. marginipennis has habits similar to other species of *Kalotermes*, some of which will be discussed in more detail.

This small common species found about buildings and in timber, such as telephone poles, etc., has been introduced into Hawaii, according to Bryan (1915). With the peculiar Hawaiian species *Neotermes* (*Calotermes*) *castaneus* Burmeister found in the native forests, these are so far the only representatives of the family Termitidae found in the islands according to Bryan. Bryan states that:

> their nests are hollowed out of the timbers in which they carefully eat out the interior, leaving an outer shell in such a manner as to exclude the light. In this hidden way they do a great many thousand dollars' worth of damage to houses in Hawaii every year. In some cases the heart of the timbers that formed the building have been so badly eaten that in time the structure has actually fallen to pieces * * *.

According to Dudley (1889) on the Isthmus of Panama, *K. marginipennis* works in hard, dry wood, choice hardwood furniture being especially relished. White ash door posts and seat rails of the first-class coaches of the Panama Railroad Company which were in daily service were destroyed by this termite. (Pl. 19, fig. 2.)

References to biological and economic literature.

1887–88. DUDLEY, P. H. Trans. N. Y. Acad. Sci., vol. 8, 1888–89, pp. 85–114.
1889. DUDLEY, P. H. Journ. N. Y. Micros. Soc., vol. 5, No. 2, April, pp. 56–70.
1890. DUDLEY, P. H. Trans. N. Y. Acad. Sci., vol. 9, pp. 157–180.
1896. SCHWARZ, E. A. Proc. Ent. Soc. Wash., vol. 4, No. 1, p. 41.
1915. BRYAN, W. A. Natural History of Hawaii, p. 425.
1916. SNYDER, T. E. Bull. U. S. Dept. Agric., No. 333, p. 15, Feb. 16.
1918. BANKS, N. Bull. Amer. Mus. Nat. Hist., vol. 38, art. 17, p. 659, Nov. 29.

KALOTERMES SCHWARZI Banks.

For taxonomy see pp. 22–25.

K. schwarzi is the commonest species of *Kalotermes* in southern Florida, yet it had not been collected until May 13, 1916, when the writer found it near Miami Beach, Florida, in logs and dead and injured trees in a mangrove swamp. This species is named in honor of E. A. Schwarz, of the United States National Museum, who, with H. G. Hubbard, has done pioneer work in this country in studying the habits of our native termites.

Pensacola, Miami Beach, near Miami (10 miles west in the Everglades, in a hammock), Cocoanut Grove (Brickell Hammock), "Front Prairie" in the Everglades, Paradise Key, Palma Vista, and Adam Key are the only localities where this species has as yet been found. P. Cardin collected soldiers of this termite at Santiago Las Vegas, Cuba, in a dead tree (Experiment Station) on October 30, 1915.

SWARMING.

This species has habits similar to *marginipennis*. It probably swarms the last of April or in May. The writer found winged adults attaining mature pigmentation at Paradise Key, May 14, 1916; at Cocoanut Grove (Brickell Hammock) on March 31, 1917; and on April 4, 1917, and April 8, 1918, at Miami Beach; and on January 1, 1919, on Ragged Key, No. 6, near Sands Key (W. E. Brown).

K. schwarzi often occurs in the same dead tree or log with *K. jouteli* Banks, *Neotermes castaneus* Burmeister, or *Cryptotermes cavifrons* Banks.

A first-form queen of this termite with slightly distended abdomen was collected by the writer at Palma Vista on March 27, 1917. This queen was in a colony in a log, across the Everglade "prairie" west from Paradise Key—Royal Palm Hammock. The queen is approximately 8 mm. in length.

Another first form queen was found on April 3, 1917, in a mangrove swamp at Miami Beach. This queen and the attendant male were in a colony in a decayed area at the base of a living red mangrove tree. The abdomen was distended and the queen was approximately 9½ mm. in length; the male was approximately 8 mm. in length. The eggs were in a cluster and then appeared to be of a pink color—possibly stained by the tannic acid in the sap of the tree. This color has since disappeared.

In a colony of *K. schwarzi* Banks, in a decaying mangrove log, at Miami Beach, Florida, the writer found a young reproductive female of the second form on April 4, 1917. This female is 6½ mm. in length, has rudimentary wing pads, is pigmented a yellow-brown color, with 13 segments to antennae, and the compound eyes pigmented grey. The abdomen is not distended. No abdominal appendices are present.

On February 19, 1919, a young reproductive pair of the second form of *schwarzi* was found at Paradise Key, Florida, in a decaying log; young and eggs were present. The female had no anal appendices present, and had the abdomen slightly distended. Both had the usual pigmentation to body and eyes. There were 14 to 15 segments to the antennae. The length of the male was 8 mm. and the female 10 mm.

The young or incipient colonies are of small size, there being usually only one-half dozen young.

The eggs are white in color, reniform in shape, and nearly 1½ mm. in length.

References to biological or economic literature.

1919. Banks, N. Bull. Mus. Comp. Zool., vol. 62, No. 10, p. 478.
1919. Thompson, C. B., and Snyder, T. E. Biol. Bull., vol. 36, No. 2, pp. 115–132.
1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, p. 379–398.

KALOTERMES JOUTELI Banks.

For taxonomy see p. 25.

This is not a common species in the United States. It occurs both in Cuba: Cayamas, 1903 (Schwarz), Hoyo de Manicaragua, Santa Clara, and Woodfred Inn, Pinares-Oriente, 1917 (W. M. Mann); and also in Mexico: Tampico and Vera Cruz; in the United States it was first found at Adam Key, a coral reef in Dade County, Florida, about 27 miles south of Miami, on May 15, 1916, and March 22, 1917, by the writer. Later—on November 29, 1918—W. E. Brown found nymphs and soldiers of this termite at Miami Beach, just across Biscayne Bay from Miami. The termites were found in a 1 by 4 by 30 inch cypress stake under his house, one of the stakes that was driven into the ground by the house builders when they were bracing the forms for the concrete piers to support the flooring timbers. The stakes were in their original position, and the one that contained the termites broke off almost at touch and was very light. It was hollow and could be crushed in the hands. The cells in the soft cypress wood containing the termites were large and long.

Later (on Dec. 9, 1918) W. E. Brown collected additional specimens of this termite in 1 by 8 inch pine forms around the base of the piers under his house; the termites were only in the moist wood in contact with the ground. Among the soldiers, nymphs, recently hatched young, and eggs was a queen of the third form over 10 mm. in length, markedly pigmented a pale castaneous color. The abdominal segments are slightly separated and evidently the queen's abdomen is distended with eggs. There are 19 segments to the antenna. The compound eyes are pigmented and the ocelli distinct, at a distance from the compound eye of more than its diameter.

In the soldier caste the compound eye is very distinct and there are 16 to 18 segments to the antenna.

This is the first queen of the third form found in the genus *Kalotermes* in the United States.

On February 18, 1919, colonies were found at Paradise Key, Florida, in dead stubs of trees, logs, and also in the heartwood of living trees; young and eggs were present. Young deälated first-form queens were found in colonies which contained eggs and young on February 18 and 21, in dead stubs of trees in the hammock.

Kalotermes jouteli was described from the soldier caste and was named in honor of the late Louis H. Joutel, of New York City, an enthusiastic student of the habits of our common termite of eastern United States, namely, *Reticulitermes flavipes* Kollar.

K. jouteli occurs with *K. schwarzi* Banks and *Neotermes castaneus* Burmeister in dead trees, logs, and branches lying on the ground. It has been found in both decaying and sound wood in contact with the ground.

No winged adults have as yet been found.

The egg is white, reniform, and 1.5 to 1.625 mm. in length.

References to biological or economic literature.

1919. BANKS, N. Bull. Mus. Comp. Zool., vol. 62, No. 10. p. 478.
1919. THOMPSON, C. B., and SNYDER, T. E. Biol. Bull., vol. 36, No. 2, pp. 115-132.

KALOTERMES MINOR Hagen.

For taxonomy see pp. 26–28.

Hagen (1858) described a small variety of "*Kalotermes marginipennis* Latr." from California under the name *minor* (as a variety only). This form is dark black-brown, with abdomen bluish-black. Hagen, in the appendix to his monograph (1860), writes that he has a male from San Diego, California, which specimen is in many respects interesting, for it proves itself precisely the size as the described var. *minor* from California, yet of the light color of the large specimens from Mexico [*K. hubbardi* Banks]. Of the latter, Hagen only had three isolated individuals and it is not improbable that all three are specimens with immature pigmentation. In one of these this is without doubt the case. The completely formed animal would then display the darker color described for the variety *minor*. (This variety of Hagen's was, of course, the lighter colored *hubbardi* Banks.)

K. minor is without doubt a distinct species. This termite occurs in the United States in California and Arizona, also probably northern Mexico.

In California, *K. minor* has been found at Palm Springs, Los Angeles (Coquillett), Cypress Point (near Pacific Grove) (Snyder), Monterey, Los Gatos (Snyder), San Jose (Bush), Palo Alto (Doane) and Niles (Snyder).

It is the commonest species of the genus *Kalotermes* in California. It lives in dead trees, logs and branches, but also injures the wood of telephone and telegraph poles, often burrowing through the dry wood high up in the pole.

H. G. Hubbard found a colony of this species on March 1, 1897, at Palm Springs, California. This was a small colony of about 40 to 50 individuals in an old *Polyporus* fungus on a cottonwood or willow tree; in this colony were young sexual individuals and two soldiers. This interesting region has a palm and cactus type of vegetation.

At California's famous Cypress Point, 8 miles southwest of Pacific Grove, the only locality where the picturesque Monterey cypress grows wild in its natural habitat, this species of termite lives in cypress stumps and old logs—only in the dry hard wood.

At Monterey and Niles the writer found *K. minor* damaging white cedar telephone poles; it bores in the dry wood to a considerable height.

At Los Gatos this termite lives in logs lying on the ground.

At San Jose *K. minor* was found in the wood of California laurel (*Umbellularia californica*).

In Arizona, *K. minor* has been found at Nogales (Calabasis Canyon). Nogales is on the Mexican border and this species probably occurs in northern Mexico; also at Tucson and Redington, Arizona.

In the Santa Catalina Mountains, *K. minor* has been found in Sabino, Bear, and Edgar Canyons, in the latter being at an elevation of 4,500 feet; also at Sycamore Springs.

In Arizona it is closely associated with *K. hubbardi* Banks, these being the two common species in the region of the Arizona Highlands. They infest dead cottonwood (sycamore), poplar, ash, walnut, and Arizona cypress trees, logs, and branches, often completely riddling the wood of the trunks of dead trees. George Hofer writes that the heartwood of living trees is also attacked. A black ash tree (*Fraxinus velutina*) was found in Sabino Canyon in the Santa Catalina Mountains with the heartwood honeycombed by *K. minor* on November 24, 1916. Hofer stated in his field notes that 70 per cent of the ash trees in this locality are in the same condition, which renders the wood unfit for commercial uses. This was probably due to the combined work of *K. minor* and *K. hubbardi* Banks.

On July 17, 1913, Morris Chrisman found a colony in a sycamore log half buried in the soil and almost eaten up by the insects, in Bear

Canyon, Santa Catalina Mountains. Eggs and winged, pigmented adults were present.

On June 13, 1918, at Sycamore Flat, Santa Catalina Mountains, Arizona, two dead first form adults of *K. minor* were found by F. C. Craighead in a small pocket filled with pellets of excrement in a stag-top of *Cupressus arizonicus* 75 feet above the ground. No hole to the exterior was observed. Both insects, deälated young parent adults, were dead and shriveled and the pocket was healed over by 10 to 15 years of annual growth.

SWARMING.

This species evidently swarms in July in Arizona. Winged adults were collected at light in Sabino Canyon, Santa Catalina Mountains, Arizona, flying with *K. hubbardi* Banks on June 20, July 10, 11, 12, 13, and 22, 1918, by George Hofer, and July 6, and 28, 1919.

The colonizing adults have dark wings. The incipient colonies are small.

No enlarged reproductive forms have been found. The first form queens found by the writer at Cypress Point and Los Gatos were only about 10 mm. in length, with the abdomen slightly distended.

References to biological or economic literature.

1858. HAGEN, H. A. Linnaea Entom., vol. 12, pp. 47 and 49. (*Calotermes marginipennis* Latreille, var. *minor*).

1860. HAGEN, H. A. Linnaea Entom., vol. 14 (Nachtrag), p. 100.

1903. HEATH, H. Biol. Bull., vol. 4, No. 2, pp. 47–63, Jan. (*Calotermes castaneus* Burmeister).

KALOTERMES HUBBARDI Banks.

For taxonomy see pp. 28–29.

This species was named in honor of the late H. G. Hubbard, of the Bureau of Entomology, who, with E. A. Schwarz, was one of the pioneers in studying the habits of our native termites. *Kalotermes hubbardi* occurs in Lower California, California, Arizona, and probably in northern Mexico.

One of the most triking characteristics of this species is the greatly elongated, club-shaped third joint of the antennae in the soldier caste.

K. hubbardi is associated with *K. minor* Hagen in the dry wood of dead cottonwood, poplar, walnut, and "palo verde" trees in canyons and along streams in Arizona. It can be readily distinguished from *minor* (which is dark bluish-black) by its pale brownish-yellow color. These two species often completely riddle the wood of trees and logs. (Pl. 20.)

Hubbard collected this termite near Tucson, Arizona, as early as 1896 (Dec. 30) in a hardened wound—a wood pecker's hole—in the stem of the giant cactus (*Cereus giganteus*). The colony was entirely isolated, being 5½ feet from the ground; this colony was small. Hubbard also found that this termite was the species commonly found damaging the rafters of "adobe" buildings in the vicinity of Tucson. (Pls. 21 and 22.)

On December 17, 1901, Theo. Pergande notes that termites (*hubbardi*) were received by the Bureau of Entomology; all had lost their wings except one. These termites were sent by A. E. Bush, from San Jose, California.

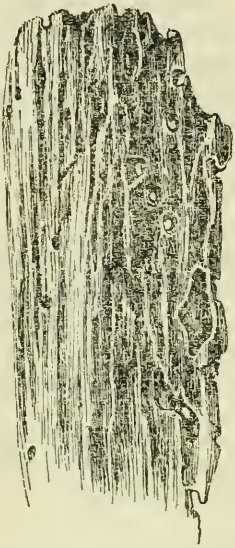

FIG. 67.—KALOTERMES HUBBARDI. ENTRANCE HOLES AND ROYAL CELLS OF FIRST FORM, COLONIZING PARENT ADULTS IN DRY WOOD OF A DEAD COTTONWOOD TREE, TUCSON, ARIZONA, MAY 12, 1917; NAT. SIZE.

On August 12, 1915, M. Chrisman found *K. hubbardi* damaging the rafters supporting the roof of a large adobe house built 25 years ago, near Redington, Arizona, elevation 2,750 feet:

> Rafters 8 to 10 inches diameter to support heavy dirt roof; house built ell-shaped between wings roofed over by heavy bridge timbers, dirt roof, 15 years; flood timbers carried 50 miles in muddy water. Termites winged specimens commenced to emerge July 11, 1915; numbers caught by tanglefoot.

SWARMING.

K. hubbardi swarms in July[1] in Arizona. E. A. Schwarz collected winged adults flying July 7 near Tucson; M. Chrisman, near Redington, on July 11, 1915, elevation 2,750 feet; George Hofer; in Sabino Canyon, at light, June 20, July 10, 11, 12, 13, and 22, 1918. In 1919 Hofer collected winged adults flying to light in Sabino Canyon on June 30, July 8, 14, and 28 (with *K. minor*); later alone on August 28. After the swarm or short flight new colonies are established by the colonizing adults, and usually after the loss of the wings has occurred.

On October 10, 1913, M. Chrisman found incipient colonies near Redington, Arizona, with the adults excavating galleries in a broken-off cottonwood limb: "no bark on side limbs; first attacks near butt; now working toward small end." There were young in the galleries,

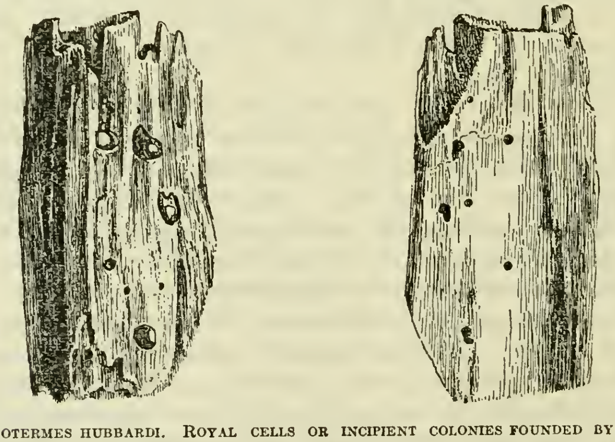

FIG. 68.—KALOTERMES HUBBARDI. ROYAL CELLS OR INCIPIENT COLONIES FOUNDED BY FIRST FORM, COLONIZING PARENT ADULTS IN DRY WOOD OF A DEAD COTTONWOOD TREE, TUCSON, ARIZONA, MAY 12, 1917; NAT. SIZE.

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[1] In 1919 adults were collected flying in Sabino Canyon from June 30 to August 28.

mostly from the end of old galleries. On December 8, Chrisman noted that the termites were near the butt in shallow cells, one pair to cell. The cells have been enlarged since October 10; the cells are shallow and oval, or "flat."

On January 23, 1917, at the Alamo Ranch, near Sabino Canyon, in the Santa Catalina Mountains, George Hofer found parent adults of *K. hubbardi* in incipient colonies in a cottonwood limb, from the top of a large tree known to be broken off during a windstorm in May, 1915. The wood was apparently sound. Young termites were in the cells, which were as yet shallow and in the sapwood. The entrance was effected under the bark and the entrance hole was of a size to permit the insects to pass it, but no wider. This led to a shallow, oval, longitudinal cell, in which were the parent adults and young termites.

As in species of *Reticulitermes*, the incipient colonies consist of a small number of individuals. Usually only about a half dozen eggs are laid for the first brood.

On May 12, 1917, near Tucson, Arizona, the writer found young parent adults in incipient colonies of this species in the dry, hard sound wood of a dead cottonwood tree, and there were young in the colonies. On May 21 similar colonies were found in a dead willow tree along the Santa Cruz River, near Nogales, Arizona. Young and eggs were also in these colonies. (Figs. 67 and 68.)

The eggs are reniform in shape and fully 1½ mm. in length, and are white in color.

KALOTERMES TEXANUS Banks.

For taxonomy see pp. 29–31.

Only the soldier of this termite has as yet been found; it was discovered by the writer on May 5, 1917, in a colony in the dry, hard wood of a log near the crest of Chalk Bluff on the Nueces River, near Laguna, Texas, 16 miles north of Uvalde. Longitudinal chambers were excavated in the wood; nymphs of sexual adults were also present. The usual impressed pellets of excrement were in the burrows.

KALOTERMES SIMPLICICORNIS Banks.

For taxonomy see p. 32.

On May 4, 1917, the writer found a colony of *Kalotermes* in a stump sunken in the ground on the bank of an irrigating ditch, at Laguna, Texas. Laguna is 20 miles north of Uvalde. Soldiers and nymphs of sexual adults were present in the colony.

The antennae of the soldiers of this termite are simple, as in species in the genus *Neotermes*. The third joint is not enlarged as in most species of *Kalotermes;* hence the name *simplicicornis*. The winged adult is as yet unknown.

Genus NEOTERMES Holmgren.

NEOTERMES CASTANEUS Burmeister.

For taxonomy see pp. 32–35.

This genus, so far as known, includes only one species in the United States, namely, *Neotermes castaneus* Burmeister.

This species, according to Burmeister, occurs in "Kalifornien (San Francisco)" (probably an error, since not found there at present). Hagen (1858) lists under "Vaterland," Kalifornien: Honduras and Guatemala, Cuba, St. Domingo (Port aux Princes), Porto Rico, Colombia, Venezuela, and Brazil (and Isle de France—another species, according to N. Banks). Hagen merely republishes Burmeister's error in giving the locality "Kalifornien."

In Hawaii, Bryan (1915) states that this species is the common termite found in the native forests. With the introduced species (*Kalotermes marginipennis* Latreille), this termite is so far the only representative of the family Termitidae found on the islands. This is not true, since *Coptotermes lacteus* Froggatt ? occurs and is injurious to woodwork of buildings at Honolulu, according to E. M. Ehrhorn (1915) and later correspondence.

Hubbard (1877) records *castaneus* from Jamaica. At a place 1,200 feet up in the hills, and consequently in a damp cool climate, on a small densely wooded island in the Wagwater River, Hubbard observed two or three small holes in the end of a small dead branch (the broken butt of a branch on a living tree about 4 feet above the ground), which was found to contain an incipient colony. The insects were isolated in a few simple burrows at the end of this short dead branch, the colony consisting of three or four sexual individuals with no wings, one or two very large mandibulate soldiers, and about a dozen nymphs. These insects were collected at Stony Hill, near Kingston, on March 10, 1877. Doctor Hagen identified the species as "*Calotermes castaneus*."

Neotermes castaneus is found in the United States and has occurred in Florida at least since 1887. Mr. Banks states that Florida's tropical colonies are almost as old as Florida. E. A. Schwarz collected this species on May 23, 1887, at Cocoanut Grove. In September, 1900, the Rev. F. L. Odenbach, S. J., of Cleveland, Ohio, received a colony of a "termite larger than *flavipes*" from Indian River, between the Narrows and Vero Post Office, which proves to be this species. He still has the colony living, and the writer has seen a soldier from it through the kindness of Father Odenbach.

N. castaneus occurs in southern Florida on the mainland, on the Upper Keys[1] or coral reefs and in the Lower Everglades. On the mainland, at Miami Beach, 3 miles across Biscayne Bay from Miami, and Cocoanut Grove (Brickell Hammock); on Adam Key, a coral reef in Dade County, about 27 miles south of Miami; and Paradise Key (Royal Palm Hammock), in the Lower Everglades, approximately 48 miles southwest of Miami, and west of West Lake, Lower Everglades, in dead saw-cabbage palmetto trees (*Paurotis*) in hammocks.

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[1] L. R. Warner collected soldiers and nymphs at Key West, Florida, in April, 1919, in a sapodilla tree.

N. castaneus burrows in the decayed wood of dead trees, logs, stumps, and branches. It is a large species and the burrows and chambers excavated in the wood are unusually large. (Pl. 23.)

SWARMING.

On May 14, 1916, winged, pigmented adults of this termite were found in a large colony at Paradise Key, Florida. It probably swarms the last of May or first of June. Winged adults attaining mature pigmentation were found on February 25, 1919, west of West Lake, in the Lower Everglades.

E. A. Schwarz collected winged adults at Cayamas, Cuba, "27/5." P. Cardin collected adults flying at dusk, at light, May 24, 1918, at Santiago de las Vegas, Cuba.

In the soldier caste the antenna is simple; that is, the third joint is not enlarged, as in most species of *Kalotermes;* also the femora are not swollen, as in species of *Kalotermes* (fig. 20).

In habits this species of *Neotermes* is not different from species of *Kalotermes.* According to Hagen (1858) a specimen in the Museum at Vienna bears the label, "frequentissime in domibus habitat?" Biologically *Neotermes* is closely related to *Termopsis,* much more so than to *Kalotermes.* There is an "ergatoid" nymph similar to that in *Termopsis;* there are similar impressed pellets of excrement which resemble those of *Termopsis.*

The Rev. F. L. Odenbach, of Cleveland, Ohio, has kept alive a colony of this species for 17 years. The interesting notes he has taken on this colony are quoted in a previous paper (Thompson and Snyder, 1919).

References to biological or economic literature.

1858. Hagen, H. A. Linnaea Entom., vol. 12, pp. 39–42 (*Calotermes castaneus* Burmeister).
1877. Hubbard, H. G. Proc. Bost. Soc. Nat. Hist., vol. 19, Dec. 26, pp. 273–274.
1915. Bryan, W. A. Natural History of Hawaii, p. 425.
1918. Banks, N. Bull. Amer. Mus. Nat. Hist., vol. 38, art. 17, p. 660.
1919. Banks, N. Bull. Mus. Comp. Zool., vol. 62, No. 10, p. 476.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, pp. 379–398, June.

Genus CRYPTOTERMES Banks.

All the species of *Cryptotermes* Banks are interesting because of the peculiar shaped head of the soldier. The front of the head has a "caved in" or truncate appearance. Only three species of *Cryptotermes* have been found in the United States: *C. cavifrons* Banks of

Florida, *C. infumatus* Banks of Texas and *C. brevis* Walker of Cuba and Mexico, which occurs at Key West, Florida.

CRYPTOTERMES CAVIFRONS Banks.

For taxonomy see pp. 35–38.

C. cavifrons was described by Banks (1906) from specimens found in rotten wood at Kissimmee, Osceola County, Florida. It has as yet only been found in Florida, and it is not probable that this species occurs further north. Haw Creek, in St. John County, is as far north as it has been found.

In southern Florida, both on the mainland and on the offshore keys, *Cryptotermes cavifrons* has been found in the more or less solid portion of decaying logs. It has been collected at Orlando; Kissimmee; Haw Creek, and Indian River (Hubbard); Palm Beach; Cocoanut Grove (Brickell Hammock) (Snyder); Paradise Key (Royal Palm Hammock) (Snyder), Long Key (Snyder), (both the latter localities being in the Lower Everglades), and Adam Key, a coral reef (Snyder).

H. G. Hubbard collected this species along the Indian River, near the Sebastian River, either on Mangrove Island or at St. Sebastian, as early as April 6, 1880. He thought the specimens collected at Haw Creek, Florida, to be "*Termopsis* n. sp." They were found in a dead palmetto "June,? 1894," and "included winged adults acquiring pigmentation." Hubbard later labeled these or other soldiers and immature winged adults "22. 6, Haw Creek, nov. genus near *Termopsis* n. sp."

Three first form young parent adults and young of this species were found in an incipient colony in the solid wood of a pecan hickory log sent from Orlando, Florida, on February 19, 1914, by J. B. Gill. The log was infested by Bostrichid beetles, through whose exit holes the termites had entered the wood.

At Palm Beach, on May 4, 1915, W. D. Freeman found specimens of termites, nymphs, and colonizing adults infesting a pine porch sill of a building. The insects were just acquiring wings and attaining their mature pigmentation. These termites are *Cryptotermes cavifrons*.

At Adam Key, an offshore key or coral reef approximately opposite Homestead, Florida, in Dade County, winged, maturely pigmented colonizing adults ready to swarm, were abundant in a colony that the writer found on May 15, 1916. Soldiers were very rare, but young nymphs were abundant in this colony, which was in the solid wood of a small red mangrove (*Rhizophora mangle*) branch on the ground at the edge of a mangrove swamp. This swamp was near the shore. The ground consisted of white coral formation with very little soil covering and vegetation. Many trees had been cut down to provide a clearing for a fishing camp, "Coccoloba Kay" Club.

In March, 1917, the writer found colonies of *Cryptotermes cavifrons* abundant in dead trees and logs at Adam Key. On March 21 a large colony or colonies, that is, several closely adjacent, overlapping colonies, each being headed by a deälated queen—were found consisting of nymphs of sexual adults, soldiers, and several reproductive adults of the first form, namely, four females and two males. Eggs and very young were present in small separate cells in fluffy, soft wood fiber. Soldiers are not common in colonies. This colony was in the hard wood of a red mangrove log. On March 22 another colony was found with a first form queen present. The queen was in the outer layers of wood near the heartwood core.

At Paradise Key, on March 26 to 28, 1917, first-form adults were found which were attaining their mature pigmentation; this had been attained by March 28. *Cryptotermes cavifrons* is a common species at Royal Palm Hammock. On March 27 a large first-form queen with distended abdomen was found in a colony. On Long Key on March 28 another true queen was found with distended abdomen in a colony in a dead tree.

The species has not been found at Miami Beach, but was collected at Cocoanut Grove (Brickell Hammock) in 1917 and 1918.

SWARMING.

This termite probably swarms in Florida in April and May, according to the location within the State. However, on February 18, 1919, winged adults of *Cryptotermes cavifrons* were found in colonies in logs at Paradise Key, in the Lower Everglades of Florida. These adults had not as yet attained mature pigmentation. In 1917 winged adults with mature pigmentation of this termite did not appear until March 28.

The reproductive forms which have been found so far have been of small size, that is, 6–7½ mm. in length, and are all of the first form.

So far as is known the habits of *Cryptotermes cavifrons* do not differ from those of the species of *Kalotermes*. The burrows in the wood are similar, consisting of longitudinal oval chambers. (Pl. 19, fig. 3.) However, the eggs are placed in small, separate pockets in fluffy wood fiber.

The impressed pellets of excrement of *Cryptotermes cavifrons* (pl. 12) are smaller than those of the species of *Kalotermes*. They are reddish when the insect is working in red mangrove wood. Often they are found in little heaps on the ground at the bases of infested dead trees or under logs.

The eggs are white, reniform, approximately 1¼ mm. in length.

References to biological or economic literature.

1916. Snyder, T. E. Bull. U. S. Dept. Agric., No. 333, p. 15, Feb. 16.
1916*a*. Snyder, T. E. Farmers' Bull. 759, U. S. Dept. Agric., Oct. 9, p. 5, footnote.
1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, pp. 379–398, June.

CRYPTOTERMES INFUMATUS Banks.

For taxonomy see pp. 38-39.

Only one colonizing adult of this termite has been found; this was collected by the late F. C. Pratt at Cotulla, Texas, on April 17, 1906. The writer spent two days at this locality the first part of May, 1917, but was unable to find a trace of this termite or its work.

CRYPTOTERMES BREVIS Walker.

This Cuban species of *Cryptotermes* is larger than *C. cavifrons* Banks of Florida. There is another marked difference; in the soldier caste the front of the head is tuberculate in outline (fig. 23, 3), whereas *cavifrons* has a smooth front (fig. 23, 2). This termite occurs in St. Thomas, West Indies, Jamaica, Mexico, and Santiago de las Vegas, Cuba (collected by P. Cardin), and also in South and Central America. According to Hagen (1860) the adults swarm in March in Cuba; E. A. Schwarz collected winged adults at Cayamas "16/2." *C. brevis* might very easily be introduced into the United States where we already have quite enough species of termites.[1]

P. Cardin kindly sent the writer the following notes, with specimens of *C. brevis* collected flying on May 28, 1918, at Santiago de las Vegas, Cuba:

> They are extremely abundant in the old building of the experiment station, especially after dusk in the spring time, and more so after heavy rains. They are harmful to furniture, books, papers, clothing, etc. The winged adults are much attracted to lights and shed their wings as soon as disturbed, or when falling to the ground, with much easiness. After losing the wings the male follows the female closely (attracted by an odor at the caudal end?). They seem to smell the caudal end every time they get close to it. Many dry up and die, but when they succeed in founding new colonies they are also found in couples. Books and papers have to be kept away from the tables and the lights put out during the swarm in this building on account of this termite.

References to taxonomic, biological, or economic literature.

1853. Walker, F. Catalog. Neuroptera, Brit. Mus., pt. 3, p. 524. (*Termes brevis* Walker.)

1858. Hagen, H. A. Linnaea Entom., vol. 12, pp. 68-70.

1860. Hagen, H. A. Linnaea Entom., vol. 14 (Nachtrag), p. 101. (*Calotermes brevis* Walker.)

1904. Desneux, J. (Wytsman, P., Gen. Insectorum, fasc. 25), Isoptera, Termitidae, p. 23. (*Calotermes brevis* Walker.)

1910. Holmgren, N. Kgl. Svenska. Vetensk. Akad. Handl., vol. 46, No. 6, pp. 53 and 55. (*Cryptotermes brevis* Walker.)

1916. Van Zwaluwenburg, R. H. Rept. Porto Rico Agric. Exper. Sta., Rept. of the Entomologist, Nov. (*Leucotermes*, species.)

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[1] Since this bulletin was sent to press, *Cryptotermes brevis* has been found at Key West, Florida. On May 31, 1919, L. R. Warner and H. L. Sanford found winged adults in water in a washbowl in a house. This was said to be a nightly occurrence and numbers get in every night between 7 and 10 p. m. The floor was covered with the shed wings of the more fortunate. The insects were infesting furniture, as the washstand, etc.

Family TERMITIDAE Banks.

Subfamily RHINOTERMITINAE Froggatt.

Genus PRORHINOTERMES Silvestri.

There is only one species in this genus in the United States, namely, *Prorhinotermes* (*Termes*) *simplex*, which was described by Hagen from Cuba. Desneux (1904) placed the species *simplex* in the genus *Rhinotermes* Hagen (1858); Holmgren (1911) placed this termite in the genus *Arrhinotermes* Wasmann (1903).

PRORHINOTERMES SIMPLEX Hagen.

For taxonomy see pp. 39–42.

P. simplex is a species native to the West Indies.

Prof. P. Cardin has kindly loaned to the junior author specimens of soldiers and winged adults of this termite he collected on "October 30, 1915, at Santiago de las Vegas, Cuba; dead tree near the experiment station."

A. H. Ritchie, Government entomologist, found workers and soldiers of *P. simplex* damaging piled lumber at Kingston, Jamaica, British West Indies, on March 15, 1918.

In the United States, *Prorhinotermes simplex* occurs only locally in southern Florida. It was first found in the United States on June 4, 1916, by W. E. Brown at Miami Beach, Florida, in the solid dry wood of a dead red mangrove tree, at the edge of a swamp, associated with *Kalotermes schwarzi* Banks. Mr. Brown and the writer had collected termites in this mangrove swamp in May, and, after the writer's return to Washington, Mr. Brown kindly sent him specimens he had later collected. The swamp was fairly dry in May, the bottom being partly dry, caked mud, and is located between the ocean and Biscayne Bay. There are many dead trees at the edges of the swamp, and termites (*Kalotermes*) are common in these trees and in the more solid wood of decaying logs on the ground.

In the spring of 1917 the writer made special effort to find specimens of this termite in southern Florida. In addition to Miami Beach, it was found on Adam Key (Dade County), an offshore reef about 27 miles south of Miami and near the Monroe County line.

Prorhinotermes simplex occurs commonly along the seacoast; at Miami Beach, in a mangrove swamp along the coast and on Biscayne Bay; at Adam Key, a coral reef in the ocean, in a dense hammock. Possibly the species was introduced into this country in logs of driftwood. This termite also occurs in pineland areas in the Lower "Everglades," the so-called Indian Hunting Ground, in the vicinity of Homestead, Florida.

Apparently *P. simplex* is similar to species of *Reticulitermes* in its habits, living in dead trees and logs; but unlike species of *Reticulitermes* this termite is not earth-inhabiting or subterranean. Sometimes, however, individuals are found in earth beneath logs. The hardest species of woods are riddled; the galleries are similar to those made by species of *Reticulitermes,* and the wood is honeycombed (pl. 24). The heartwood of logs is often more readily penetrated through cracks, and these termites work between the layers of wood. Open places or hollows encountered in logs are, as by species of *Reticulitermes,* filled in with frass and excrement. The galleries are spotted with the moist excrement. Moisture is necessary for this termite, as it is in colonies of species of *Reticulitermes* and there is much very moist, finely digested excreted wood in the galleries in logs.

The castes apparently consist of the same forms as in the genus *Reticulitermes,* workers, soldiers, and at least two types of reproductive forms. The workers have yellow heads. (Fig. 26).

No winged forms have as yet been found in this country, but nymphs with peculiar wing buds (fig. 69, 2) occur in colonies. These wing buds are really expanded thoracic plates and not ordinary wing pads. The buds are fused in the mid line; there is a slight median groove. The buds are not straight, as in *Reticulitermes,* but curved. Due to this plate-like character of the buds, these nymphs may be of the second form. However, the wing venation is not so pronounced in nymphs of the second form. On April 10 and 18, 1918, colonies were found by the writer in a mangrove swamp, near Miami Beach, with these nymphs with short wing pads present. An especially large colony was found on April 18 containing large egg clusters.

Only two types of reproductive forms have as yet been found in colonies of *P. simplex* in southern Florida, the normal first form and the third form (fig. 69, 1.). Unlike in colonies of species of *Reticulitermes,* the third reproductive form is a common type. Other differences are pigmentation to the eye (the ommatidia of the compound eye are well developed) and characteristic pigmentation to the body. There are 17 to 18 segments to the antenna, as in that of the winged adult, while in the worker there are 16 to 17 antennal segments, but occasionally 18.

These apterous reproductive forms are numerous in colonies, one large colony found by the writer at Adam Key, Florida, on March 21, 1917, in an "ironwood" log (*Eugenia confusa*), containing 8 females and 2 males. The females are from 5 to 6½ mm. in length with distended abdomens. Similar conditions were present in several other large colonies of this termite found by the writer at Adam Key and Miami Beach, from March 21 to April 11, 1917. Colonies are often of large size, consisting of thousands of members. On April 29 and 30, 1918, colonies were found in a mangrove swamp at Miami Beach with reproductive individuals of the third form present. The females, with distended abdomens, ranged from 6 to 7½ mm. in length.

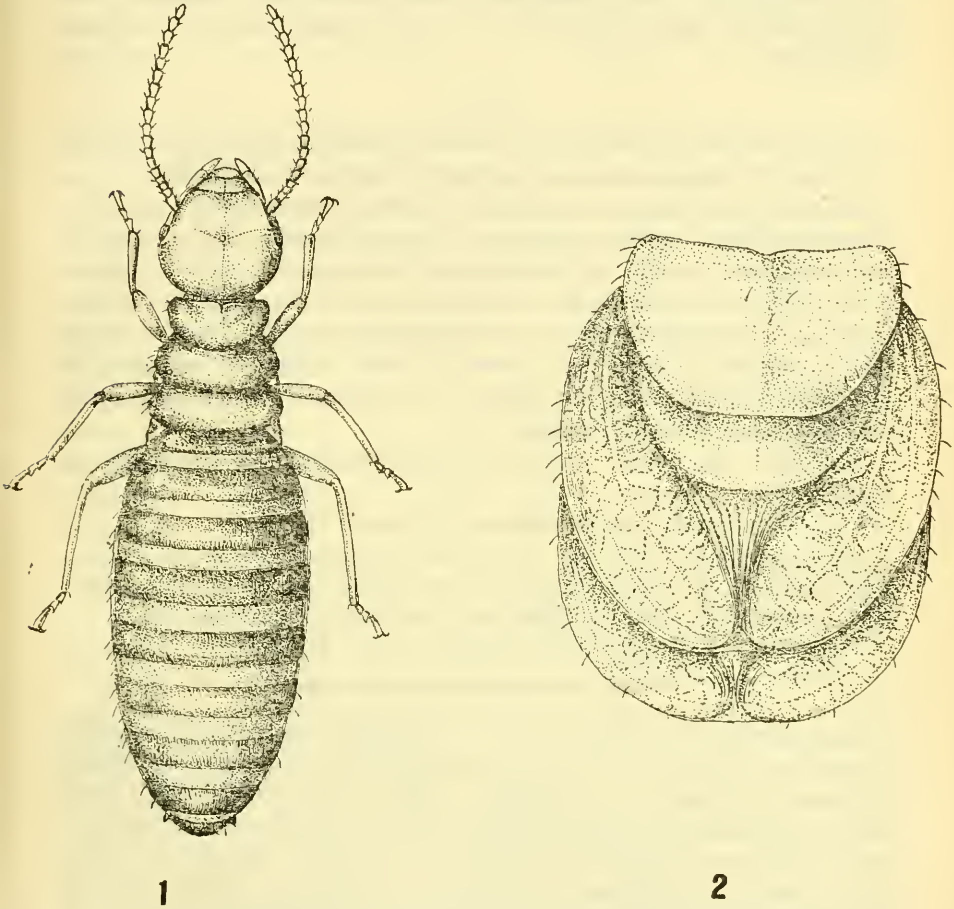

Fig. 69.—1. Prorhinotermes simplex. Dorsal view of apterous queen of the third form. × 16. 2. Peculiar fused wing pads on nymph of second form. × 43.

This termite appears to be well established in this swamp along Biscayne Bay, colonies being fairly common. Reproductive individuals of both the first and third forms occur, being, of course, in separate colonies.

In pineland near Goodburn Hammock, 4 miles west of Homestead, Florida, a few colonies of *Prorhinotermes simplex* were found by the writer on April 22, 1918, in decaying logs of Cuban pine. This is the first record of this termite occurring on the mainland of southern

Florida; previously it has only been found along the seacoast (Miami Beach, across Biscayne Bay) and on the offshore keys.

In one colony in this locality young reproductive individuals of the third form were found; they were very young, but the head and body are pigmented a dark yellowish-brown color. There are 17 to 18 segments to the antennae; 4 were males and 7 females. The abdomens of these females or young queens were but slightly distended.

SWARMING.

It is not known when this termite swarms in the United States. In Cuba, *P. simplex* swarms during the last part of October.

Recently established or incipient colonies are small in numbers, comparing with similar colonies of *Reticulitermes;* they consist of not more than one dozen individuals. Such colonies are established under bark, at the bases of dead trees, just above ground, or in logs; in holes or wounds in trees; or in the abandoned burrows of wood-boring beetles in logs and trees. In red mangrove swamps the empty pupal cells of the mangrove borer (*Chrysobothris tranquebarica* Gmelin) are commonly utilized.

The eggs are white, reniform, approximately 0.8 to 1 mm. in length.

References to biological or economic literature.

1918. Caudell, A. N. Can. Ent., vol. 50, No. 11, pp. 375–81, Nov.
1919. Banks, N. Bull. Mus. Comp. Zool., Camb., Mass., vol. 62, No. 10, p. 480.
1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, p. 379–398, June.

Genus RETICULITERMES Holmgren.

The species of this genus are of relatively northern distribution throughout the world; they are subterranean in habit and are among the most destructive wood borers. Colonies are found in dead trees, logs, and stumps and in the ground under wood, stones, and manure, etc. They usually follow the grain when burrowing in wood and honeycomb it; moisture is absolutely necessary. Species of this genus are widely distributed throughout the United States, but are not so common in the far north and far Southern States.

The limits of a colony are hard to define; a single colony may extend over considerable ground. Old colonies contain large numbers of individuals, probably running up into the ten thousands. The habits of two species of this genus have already been discussed in detail (Snyder, 1915, 1916, and 1916*a*). All of our native species of *Reticulitermes* appear to have similar general habits, differing, however, in the time of swarming. Apparently different species never swarm simultaneously in the same locality.

Species of *Reticulitermes* were found to be absent or not common on the mainland of the east coast of southern Florida, where outcrops of eroded, hard, oolitic limestone rock (Miami oolite) projecting through the soil are common, in the form of low bare ledges. Possibly the species of the subterranean genus *Reticulitermes* could not thrive on these coral reefs or islands, since they could not bore through the coral. Similar conditions prevail on the mainland where there are outcrops of the oolitic limestone rock, especially in the pineland "barrens."

Coral, limestone rock, and dry sand in localities near the coast are all unfavorable conditions in which to excavate habitations, and the usually abundant species of *Reticulitermes* were rare or absent.

Their absence or rarity in these locations may be due, however, to the fact that the species which are not subterranean might be better adapted to survive introduction living in driftwood logs, such as species of Kalotermitidae and the species *Prorhinotermes simplex* Hagen, which occur in "hammocks" on the offshore keys. However, species of both genera occur in the Lower Everglades. *P. simplex* has somewhat similar habits to species of *Reticulitermes;* that is, it lives in moist wood which it infests directly, however, and not indirectly through the ground.

Wherever they occur—in India, Japan, Europe, or the United States—the species of *Reticulitermes* are very injurious to the woodwork of buildings and their contents. In the United States such damage is more common in the Southern States, but damage has been recorded as far north as Manchester, New Hampshire, and the shores of the Great Lakes (Benton Harbor, Michigan).

No insects occurring in houses are capable of doing greater damage than termites, for the injuries are often hidden until the damage is beyond repair. Fortunately they are not often present in houses in the Northern States. Such damage is more common and serious in the Southern States, and, as the Tropics are approached, becomes a menace to the woodwork of buildings. Aside from the foundation timbers (pl. 25), the interior woodwork of buildings and the material stored therein, such as books, paper (pl. 26), cloth, etc., termites will also destroy stationary furniture and even the carpet, rugs, oilcloth or linoleum laid over infested flooring.

The swarming of the colonizing adults in infested buildings often causes considerable surprise and anxiety to the inhabitants. The insects get into the food and spread all over the table at meal time; they crawl over people and fly in their faces, and are a general nuisance. These insects swarm in great abundance and are often swept up in large numbers by the careless householder without further thought, being considered merely "winged ants," probably coming from out-of-doors, and it is not realized that they threaten the integrity of the building as well as its contents. In reality, this swarm should be regarded as a warning and a danger signal.

Damage occurs in large cities as well as in rural communities. Much trouble is due to the fact that many buildings are carelessly or poorly constructed. Methods of preventing damage by termites in this genus, due to their injuriousness, have been made the subject of special study. The measures found successful have already been discussed.

RETICULITERMES FLAVIPES Kollar.

For taxonomy see pp. 45–46.

The common species of the genus *Reticulitermes* in the United States, *flavipes*, was described by Kollar in 1837. This termite is widespread in the eastern United States, its geographical distribution being from (Canada?), Kittery, Maine (Thaxter), southward to the Florida Everglades. However, colonies are not as common in southern Florida as they are in Virginia; nor is the damage to the woodwork of buildings as great.

The Superior Highlands appear to be a northern limit of this termite. It does not occur or is rare in certain regions of the extreme north and is not so common in the far south. There is a doubtful record of termites occurring in Wisconsin. In October, 1917, a paper mill located at Rothschild, Marathon County, Wisconsin, shipped some paper in wooden cases to New York for export. The paper was found to be damaged by termites (*Reticulitermes*, species) workers of which were in the paper. These insects may have been in the case lumber in Wisconsin since it had been in the pile for several years.

R. flavipes occurs in northern Mexico (Matamoras), (C. R. Osten Sacken.)

Thus this species occurs from the Atlantic Ocean westward beyond the Mississippi River in Missouri, Arkansas, and Texas, but is restricted to the region east of the Great Plains.

R. flavipes has been introduced into Europe and, according to Hagen (1876), our species has caused great damage, some years ago gaining access to one of the Imperial hothouses at Schoenbrunn, Vienna, and in spite of all efforts to save the building it was necessary ultimately to tear it down and replace it with an iron structure.

Out-of-door colonies in the vicinity of Washington, District of Columbia, and the northeastern United States, are dormant during the winter months, the insects retiring into the subterranean passages of the nest by the middle of November to December, depending upon the season. By the last part of February or early or late in March, depending on weather conditions, signs of activity are to be observed in colonies in the vicinity of Washington.

SWARMING.

The colonizing individuals of *Reticulitermes flavipes* usually swarm in the morning during April and early May in the vicinity of Washington, District of Columbia.

On April 18, 1912, nymphs of the first form (with long wing pads) of *R. flavipes* were fully developed and ready for the final molt in colonies at Falls Church, Fairfax County, Virginia. The quiescent stage was passed through and the final molt occurred from April 18 to 27. The first swarm in large numbers was on May 8. On May 14 swarms occurred in lesser numbers. In 1913 the nymphs were mature on April 8, the final molt taking place from April 8 to 17; the swarm occurred on April 25, 1913. In 1914 these nymphs were mature on April 22, the final molt occurred from April 22 to May 2, and the insects swarmed on May 10. In 1915 nymphs of the first form were mature on April 18, the final molt took place from April 18 to 27, and the swarm occurred on April 27 and May 6.

Apparently nymphs of the first and second reproductive forms may attain their full mature length in the autumn. During late October and November, 1918, nymphs were found in colonies at Falls Church, Virginia, on which the wing pads were of full length and with a light-pinkish pigmentation to the eyes, as Dobson has found to be the case in the vicinity of Boston, Massachusetts. However, full maturity of the nymphs of the first form, with the attainment of opaqueness of the wing pads and fuller pigment to the eyes, is not attained until spring (the last of March or first of April) in Virginia.

On May 6, 1915, sexual adults emerged at 8.30 a. m. from railway ties and the wooden platform of the electric railway station at Falls Church, Virginia. Again on May 6, 1915, S. A. Rohwer observed a small swarm emerge from the front porch of a cottage near East Falls Church, Virginia. The emergence began at 8.15 a. m. and lasted until 8.35 a. m.; it was at its maximum at 8.25. All of the insects flew away to the southeast. In 1916 nymphs were mature on April 24, the insects passed through the final molt from April 26 to May 2, and the swarm occurred on May 8. On May 8, 1916, a swarm occurred from the electric railway station at Falls Church, Virginia, at 8.20 a. m. Farther north the swarm occurs later, usually the last of May or in early June.

During the latter part of April, 1912, nymphs with short wing pads, or those of the second form (Lespès), were found in colonies at Falls Church, Virginia. These nymphs appear to be more active than nymphs of the first form; they have but slight pigmentation of the compound eye. Nymphs of the first form have a reddish-brown pigmentation to the compound eyes.

From March 24, 1919, to April 8, 1919, nymphs of the second form of *flavipes* were common in colonies at Falls Church, Virginia.

By April 21, 1919, at Falls Church, Virginia, it was no longer possible to find any nymphs of the second form in colonies of *flavipes*. Most of the first form nymphs had molted and had transformed to winged pigmented adults—mostly with nearly mature pigmentation. It was still possible, however, to find some mature nymphs of the first form with opaque wing pads and nymphs which had recently molted and which were in the "airplane stage;" i. e., with the wings as yet unexpanded and extended out from the body as planes. On this date the flower buds of the flowering dogwood (*Cornus florida*) were swelling.

On April 23, mature and recently molted first form nymphs were still present in colonies with winged adults with pigmentation nearly mature. These adults flew when colonies were cut into. A few first flowers of dogwood were out, the general condition being flower buds swelling.

On April 28, 1919, at Falls Church, Virginia, the winged adults in most colonies had attained mature pigmentation. In a few colonies mature nymphs of the first form with opaque wing pads and recently molted nymphs in the "airplane stage" were present. The blossoms of dogwood were half out. A few young nymphs of reproductive forms with short wing pads were found in colonies.

By April 30 the adults had swarmed from colonies. Dogwood was nearly in full bloom.

Nymphs of both first and second forms pass through quiescent stages during the final molt, which are of comparatively short duration. On April 25, 1912, at Falls Church, Virginia, the first molting nymphs of the second form were observed in colonies; April 22, 1913 and 1914; April 27, 1916.

On April 5, 1915, a swarm occurred at Washington, District of Columbia. In Washington swarming sometimes occurs very early in infested buildings. On February 14, 1916, a swarm occurred in the dark, damp heated basement of a building; on February 19, 1917, a swarm emerged from damaged flooring in a building in Washington, and on February 16, March 14, 26, 31, and April 2 and 13, 1918. Later swarms in infested buildings at Washington, occurred on April 13 and May 6, 1918.

In the extreme south this insect swarms earlier—Palatka, Florida, February, 1868, and February 13, 1875. However, this species swarmed as late as May 19, 1875, at Enterprise, Florida (Hubbard), and May 11, 1883, at Crescent City, Florida (Hubbard). On March 4, 1919, winged pigmented adults, ready to swarm, were found in a colony in a stump at Ortega, near Jacksonville, Florida; first flowers were out on flowering dogwood on this date. Yet a swarm occurred in an infested building at Seabreeze, Florida, as late as April 7, 1919. This was probably not the first swarm from this colony. A swarm occurred outdoors at Texarkana, Arkansas, at 9.30 a. m. on April 8, 1919. Winged adults were collected flying near Mammoth Cave, Kentucky, on May 2, 1874 (F. H. Sanborn); Newark, Delaware, May 19, 1892; on May 16, 1914, this species swarmed at Kanawha Station, West Virginia, from an infested building; in 1915 the insects emerged on May 8 (Hopkins). At Kanawha Station, West Virginia, on May 5, 1919, there was a swarm from a sill of the house, south end; the dogwood flowers were with first pollen falling. The swarm started about 10 a. m. with the temperature at 71° and continued until noon when it had ended. On the 6th there was another swarm at about the same time.

In the Northern States *flavipes* swarms later, usually during the last of May or early June. Hagen (1878) mentions an exceptionally large swarm of *flavipes* occurring in Massachusetts on May 19, 1878. Hagen states that this is an early appearance for the insects; they commonly arrive in the middle of June. Winged adults were collected at Wellesley June 1, 1892, and June 4, 1900, at Dover, and June 8, 1917, at Forest Hills, Massachusetts. However, winged adults were collected at Sherborn, Massachusetts, May 21, 1899, and in May, 1906, by J. Barlow at Kingston, Rhode Island. Sexual adults came up through cracks in the floor in a building on March 30, 1908, at Philadelphia, Pennsylvania. On May 25, 1913, the writer found winged adults with mature pigmentation in a colony at Charter Oak, Pennsylvania. A. B. Champlain found winged adults in colonies at Westbury, Long Island, New York, on May 28, 1916. On May 16, 1916, this species swarmed in an infested building at St. Louis, Missouri. In 1918 *flavipes* swarmed on March 6, in an infested building at Rural Valley, Pennsylvania. On May 12, 1918, C. T. Greene collected winged adults of *R. flavipes* at Lyme, Connecticut, in a colony under a stone; they had nearly acquired mature pigmentation. On January 20, 1919, there was a swarm in an infested building at Bloomfield, New Jersey. On March 6, 1919, there was a swarm in an infested building at Williamsport, Pennsylvania. The swarm occurred when the sun was high.

The sexual adults usually emerge approximately one month earlier in infested buildings than under normal outdoor conditions.

In infested buildings at Brooklyn, New York, adults swarmed on March 30 and May 29, 1917. Winged adults in the United States National Museum bear the label "Albany, N. Y., March 29, '99, W. G. Lewis."

Winged adults have also been found in the fall of the year: Bergen Beach, New York, Sept. 14, 1908; at Meldrim, Georgia, Nov. 3, 1915

(Snyder), and in November, 1917, Savannah, Georgia, by E. B. Griffen; and at Montgomery, Alabama, on Oct. 17, 1917 (H. C. Jones).

Often several swarms emerge from the same colony in the same year, sometimes as many as four separate swarms extending over a period of one month. In size, however, the first swarm, from the writer's observations, is usually the largest.

Apparently rainfall has no influence on the time of swarming. It is not essential that this species, or other species of *Reticulitermes* in eastern United States, swarm during, or just after, rainfall—as in the Tropics and in arid or desert regions in the United States, since the ground does not become caked and cracked through drought as in portions of the Southwest.

Phenological correlation of the first swarming of Reticulitermes flavipes Kollar with the bloom of the flowering dogwood (Cornus florida) (pollen ripe) at Falls Church, Virginia.

	First swarming.		First full bloom.
1912	May 8	1912	May 8.
1913	April 25	1913	April 26.
1914	May 10	1914	May 11.
1915	May 6	1915	May 1.
1916	May 8	1916	May 8.
1919	between April 28 and 30	1919	May 2.

ABNORMALITIES.

Certain abnormalities have been noted (Snyder, 1915) in the metamorphosis of the nymphs of the first form to the winged adult. Individuals may be observed with partial pigmentation to the chitinized parts, but with the wings partially unfolded, or unfolded but crumpled wings or merely the long opaque wing pads of the mature nymph before the last quiescent stage and molt. Other individuals that may have the mature body pigmentation, but distorted or poorly developed wings, or even wing pads, emerge with the normal winged adults at the time of the swarm.

It was formerly explained that these abnormally developed individuals were merely abnormalities due entirely to unfavorable conditions of moisture. Now, however, when considered with certain "intermediate" forms, these abnormalities may be termed fluctuating variations or mutations from the normal winged reproductive forms (Thompson and Snyder, 1919). These abnormal forms, together with the "intermediate" forms, represent almost a complete series beginning with normal wings and ending with the apterous reproductive form, a large intergrading series. On these intermediate forms the length of the wing pads ranges from the long wing pads of the nymphs of the first form to vestigial buds.

These abnormalities and "intermediates" have partial pigmentation to the body, and the intermediates have various stages of eye development, ranging from partial mature pigmentation to the eye to merely traces of the eye.

In the forms which develop abnormally at the time of the quiescent stage and final molt of the nymph of the first form there are various forms which might be compared to the "club," "vestigial," and "stumpy" wings of the mutants of *Drosophila melanogaster* (*ampelophila*).

The writer has, unfortunately, only preserved a small series of these abnormalities which occur "wild," or in nature, as well as in rearing cages or artificial colonies; these are mostly females—5 females and 3 males.

In artificial colonies nymphs of the second form sometimes attain a deep, dark pigmentation.

New or incipient colonies are established, after a short flight, by the winged colonizing sexual adults of the first form, that swarm. These colonies are formed in the earth under decaying wood lying on the ground; in this wood; under loose bark on dead trees or logs; or in crevices in trees—anywhere where there is a sufficient supply of moisture. Within a few days after the swarm the young parent adults may be found in such sites, but they later disappear, penetrating more deeply into the wood.

These winged males and females of the first form, after losing the wings, become the reproductive forms of the normal or first form type with wing stubs. Reproductive forms of this type are not rare or difficult to find at the proper season in colonies of eastern United States, but in the region of the Great Plains they must be far below ground during dry seasons, since they have not been found as yet. Conditions in these regions may be somewhat similar to those in Sicily, where Grassi (1893) studied the habits of *R. lucifugus* Rossi, and account for the fact that he was unable to find this type of reproductive form. Grassi believed that the colonizing forms were all destroyed or irretrievably lost at the time of the swarm.

Two other types of reproductive forms are present in colonies of *flavipes*, those of the second form, which develop from the nymphs of the second form (Lespès) with short wing pads, and those of the third form with no wings or wing pads but wholly apterous, resembling the worker or "ergatoid." All of these reproductive forms have been described and figured (Snyder, 1915 and 1916).

The reproductive individuals of the second form may be abundant in colonies; usually there are many females and but few males. Sometimes a male of the first form may be present with a number of females of the second form.

Mature queens of the third reproductive forms have as yet been found but rarely. Only one mature adult male though numerous nymphs of this form have been recognized.

The queens of the species of *Reticulitermes* do not reach extraordinary size and never lose the power of locomotion. They probably change their location in the colony to conform to the most favorable conditions of temperature and moisture and go below the frost line in the ground in winter. There is no permanent, centrally located royal cell. The largest queen of *flavipes* so far found was of the first form and was 14½ mm. in length and 4 mm. in width, measured while living. The attendant males have the abdomens slightly distended. The largest queen of the second form measured 12 mm. in length (alcoholic specimen), and the largest third form queen was 7 mm. in length, measured while living.

The finding of these reproductive forms and the conditions under which they occur in colonies have already been discussed in previous papers. A few additional later findings will be recorded.

On April 29, 1915, Dr. H. von Schrenk found five queens of the second form of *R. flavipes* in the decayed wood at the base of a white cedar telephone pole at St. Louis, Missouri. The antennae consisted of 14–15 segments, there was pigmentation to compound eyes, abdomens were distended irregularly, distorted in outline, lumpy due to being unevenly distended, the pigmentation was pale brown or grey, length 8½ to 10 mm.; wing pads were as in nymphs of the second form.

On May 15, 1915, Prof. W. M. Wheeler found a large queen and a king of the first form of *flavipes* at Blue Hills near Boston, Massachusetts. This queen was 10 mm. in length with the abdomen markedly distended.

On July 26, 1915, a first form or "true" queen (*flavipes*) 13 mm. in length and a king 6.5 mm. in length were found by the writer at Falls Church, Virginia, in a decaying tulip tree stump, in a longitudinal royal cell, the burrows leading to the royal cell being round and of a diameter as large as the distended abdomen of the queen.

During an inspection of telephone poles, from October 15 to 26, 1915, near Savannah, Georgia, several reproductive forms were found in the bases of the poles. A queen of the first form 10 mm. in length (measured after being preserved in alcohol) with distended abdomen, was found in one colony of *flavipes*, and four queens and five males of the second form, the queens having distended abdomens, the largest female being 8 mm. in length (measured after preserving) in another colony.

On June 23, 1916, at Dead Run, Virginia, a first form queen of *flavipes* was found by the writer in a cell in an oak stump in the more solid outer layers of wood, about 1 foot from the ground. This queen was 15 mm. in length and 4 mm. in width (measured after preserved in alcohol).

On March 28, 1917, C. A. Mosier and the writer found a colony of *flavipes* in a decaying log on Long Key, in the Lower Everglades of Florida, in pineland. This colony contained young reproductive individuals of the second form, 32 females and 8 males being the relative numbers of the sexes. Some of these individuals had quite a dark brown or castaneous pigmentation to the chitinized parts. The queens had only slightly distended abdomens, the largest being only 6 mm. in length. These second-form individuals were probably of the same brood as a few winged first-form adults which were present. In no instance have winged first-form adults been found in colonies of species of *Reticulitermes* which contained old second form reproductive individuals. Abdominal appendices were present in these males of the second form but absent in the females.

On August 20, 1917, the writer found a large fertilized first-form queen with distended abdomen of *flavipes*, 15 mm. in length (measured after preserved in alcohol), and attending male in an oak stump at Kearney, Virginia, in a moist woodland. This queen was in a large cell in the more solid sound wood at the root collar, about 1 foot above the ground. Eggs and young were also present; the eggs were in large clusters.

A. B. Champlain found on August 28 a large first-form queen with distended abdomen and male in a cell in the more solid heartwood of a stump at Falls Church, Virginia. The cell was near the ground and was an enlarged main gallery.

On August 29 the writer found another large first-form queen with distended abdomen and male in the more solid wood of a decaying log lying on the ground near the Maryland and District of Columbia boundary line, beyond Georgetown, in a moist woodland.

In November, 1917, E. B. Griffen, of the American Telephone & Telegraph Co., while inspecting the bases of telephone poles near Savannah, Georgia, found a large first-form queen of *flavipes* in the base of a chestnut telephone pole. This queen had a distended abdomen and was 10½ mm. in length.

In Brickell Hammock, Cocoanut Grove, Florida, on April 23, 1918, the writer found a young queen of the second form, 6.5 mm. in length, in a colony. The pigmentation is grey-brown and there are 14 segments to the antennae.

Near Balls Hill, Virginia, on June 19, 1918, the writer found a queen of the first form of *R. flavipes* that was 16.5 mm. in length, measured after preserving in alcohol. This queen was in a colony in a decayed log of Virginia scrub pine in woodland. The cell in which the queen was located was in the outer layers of wood, but in the more solid wood of a large branch knot. No male was found and doubtless escaped. Numerous eggs were present in the colony which was large.

Near Dead Run, Virginia, on the same day, 43 reproductive individuals of the second form were found in a fairly large colony in a decayed oak log. The termites, including these reproductive forms (28 queens and 15 males) were in the more decayed outer layers of the wood. This is a relatively large number of males for this number of females. The reproductive forms were not all together, but grouped in lots of half dozen or more in chambers in different parts of the log. Eggs were very numerous in this colony; they were in large clusters in different parts of the log.

The females had distended abdomens, the largest being 10 mm. in length; the average length was 8.2 mm. The pigmentation was of the characteristic grey-brown color of this form; there were 17 segments to the antennae. One female had a black band of fungus on an abdominal tergite. Nymphs with short wing pads were present in the colony; they are probably of the second form.

On July 9, 1918, at Falls Church, Virginia, R. A. St. George and the writer found enlarged third form queens in a large colony of *flavipes* in a decayed Virginia scrub pine stump about 3 to 4 inches above the ground. This was about noon and some of the queens were exposed by the first blow of the hatchet; 17 queens were present; the largest queens were 9.5 mm. in length and 2.75 mm. in width measured while living. Wing pads were absent and the abdomens of the queens were apparently more cylindrical than those of the second form. The pigmentation was of a light straw color; the antennae had 16 segments. No males were recognized.

Eggs in clusters and young were present. These eggs were apparently not different from those laid by the queens of the first and second forms. A few nymphs of the second form (?) with short wing pads were in this colony. This is the greatest number of this form of queen found in the United States, there being more present than the total number previously found in all species of Nearctic *Reticulitermes*.

Termitophilous Staphylinid beetles were present in this colony.

On July 18, 1918, a pair of first-form reproductive individuals was found by the writer in a decayed stump at Falls Church, Virginia. The queen was not greatly enlarged, being under 14 mm. in length measured living. Eggs and young were present.

At Veitch, Virginia, on July 26 R. A. St. George and the writer found six enlarged second-form queens in a colony in a decaying stump. Nymphs of the second form with short wing pads were present in this colony. Eggs and young were in the colony.

The writer found a large first-form queen of *flavipes* with attending male in the partly decayed root of a living oak tree at Falls Church on August 2. The queen was 12.5 mm. in length and 4.5 mm. in width (measured living). Large clusters of eggs and young were present. The termites had entered the root through the burrows of a large Prionid beetle; the colony was large. The male was attracted to the female and remained with her in a cell in the more solid wood.

In another nearby colony in a decayed pine stump a large queen and attending male were found. The queen measured from 12.5 to

16 mm. in length and 2.5 to 4 mm. in width, according to whether the body was distended or contracted in crawling. The male was attracted to the female, although not found with her. The queen was in a cell in the outer layers of wood. Numerous eggs and young were present.

In this same woodlot a male of the first form was found in a cell near a knot in a decaying pine stump. No queen was found, although very large egg clusters were present. Undoubtedly this male is a mature king, and the queen escaped or was crushed.

On August 19, 1918, M. A. Murray found a mature first-form king of *flavipes* in a large colony in a decayed chestnut stump at Chain Bridge, Virginia. No queen was found; there were young in the colony.

On April 21, 1919, a very early record for the occurrence above ground of reproductive forms of *flavipes* was noted. In a decayed stump, about 1 foot high, 29 females of the second form were found; 14 of these females had their abdomens distended (the largest queens being 8 mm. in length), evidently had been fertilized, and were egg laying queens. The abdomens of 15 were undistended and they might easily have been mistaken for males. These females had the usual pigmentation of reproductive individuals of the second form, and there were no anal appendices present. There were 15 to 18 segments to the antennae and the eyes were slightly pigmented. Several females had longer wing pads than is usual. No second form males were captured or observed. Young were present in this colony. About one-half dozen winged, pigmented first-form adults were also present; both sexes were represented—6 females and 2 males.

It is a question whether these queens with distended abdomens are young and were produced this year contemporaneously with the winged first-form adults, or whether they are the parents of the entire colony.

On April 30 M. A. Murray found a first-form queen in a colony at Falls Church, Virginia. This is an early record for the finding of a queen above ground. The colony was in a decayed pine stump and was not large; 676 workers, 65 soldiers, 30 nymphs of reproductive forms and 26 young. This was just after the swarm.

The queen had a distended abdomen and is 12 mm. in length (measured after being preserved in alcohol). There are 14 segments to the antennae.

While all of the first-form queens which have been found, with few exceptions, were of large size, none of them were over 14½ mm. in length when measured living.

It will be seen from these notes and what has already been published that first form reproductive individuals are not rare in colonies of *flavipes* in the eastern United States.

As previously stated, the rate of egg laying is slow. Six to twelve eggs compose the first batch of the young royal couple in incipient colonies. There is no data on the rate of egg laying in well established colonies and, while probably very great in long-established colonies, it does not approach that of tropical species of termites. In large colonies thousands of eggs are often present. The only data at hand is that relating to egg laying under artificial or abnormal conditions. On June 23, 1916, at Dead Run, Virginia, a first-form queen (*R. flavipes*), 15 mm. in length, 4 mm. in width (measured after being preserved), was found in a cell in an oak stump, in the solid outer layers of the wood, about 1 foot above the ground. The queen was placed in a vial at 11 a. m. and at 3 p. m. the queen was dead and 30 eggs were in the vial.

The period of maximum egg production is during the warm months, that is, the middle of May to early September, near Washington, District of Columbia, and in the southeastern United States. In artificial colonies in heated buildings eggs have been found during every month of the year.

The egg is white, reniform, and approximately 0.68 mm. in length, but varies in size.

All the eggs do not hatch at the same time, and the nymphs are to be found in various stages of development, hence the workers and soldiers do not all mature at the same time. Nymphs are to be found in molting quiescent stages from early May till the middle of September in the vicinity of Washington.

References to biological or economic literature.

1858. Fitch, A. Trans. N. Y. State Agr. Soc., vol. 17, p. 694 (1857).
1858. Hagen, H. A. Linnaea. Entom., vol. 12, pp. 184–5 (1857) (*Termes flavipes* Kollar).
1860. Hagen, H. A. Linnaea. Entom., vol. 14 (1859) (Nachtrag), pp. 107–8.
1860. Scudder, S. H. Proc. Bost. Soc. Nat. Hist., vol. 7, pp. 287–8.
1876. Hagen, H. A. Amer. Nat., vol. 10, No. 7, pp. 401-410, July.
1877. Grant, R. D. Trans. Acad. Sci. St. Louis, vol. 3, Journ. of Proc., p. cclxix, Nov. 19.
1877. Leidy, J. Proc. Acad. Nat. Sci. Philadelphia, vol. 29 (for 1877), pp. 146–9, June 26.
1877. Riley, C. V. Trans. Acad. Sci. St. Louis, vol. 3, p. 269, Dec.
1878. Hagen, H. A. Proc. Soc. Nat. Hist. Bost., vol. 20, p. 118, Nov. 27.
1878. Lintner, J. A. Entomology. Proc. Albany Inst., vol. 2, pp. 48–50.
1881. Leidy, J. Journ. Acad. Sci. Phila., ser. 2, vol. 8, pp. 425–47, Feb.
1883. Packard, A. S. Third Rept. U. S. Ent. Commis., pp. 326–329.
1885. Hagen, H. A. Can. Ent., vol. 17, No. 7, pp. 134–6, July.
1885. Hubbard, H. G. Insects Affecting the Orange, chap. 9, pp. 121–5.
1887. Scudder, S. H. Can. Ent., vol. 19, No. 11, pp. 217–8, Nov.
1889. Atkinson, G. F. Some Carolina insects. 1st Rpt. So. Car. Exp. Sta. for 1888, pp. 19–56.
1889. Casey, T. L. Ann. N. Y. Acad. Sci., vol. 4, pp. 384–387, March.
1889. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 1, No. 3. pp. 160–161, March 30.

1891. Scudder, S. H. Psyche, vol. 6, No. 197, pp. 15–16, Jan.
1893. Joutel, L. H. Journ. N. Y. Ent. Soc., vol. 1, No. 2, pp. 89–90, June.
1893. Riley, C. V., and Howard, L. O. Insect Life, U. S. Dept. Agric., vol. 6, No. 1, p. 35, Nov.
1893. Stokes, A. C. Science, vol. 22, No. 563, pp. 273–6, Nov. 17.
1894. Riley, C. V. Proc. Biol. Soc. Wash., vol. 9, pp. 1–74, figs. 12, April.
1895. Forbes, S. A. 19th Rept. State Ent. of Ill. for 1893 and 1894 (*Termes flavipes* Kollar).
1895. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 3, No. 2, pp. 73–78, January 8.
1897. King, C. B. "Ent. News," vol. 8, No. 8, pp. 193–6, Oct.
1897. Porter, J. F. Bull. Mus. Comp. Zool., vol. 31, No. 3, pp. 45–68, Oct.
1901. Howard, L. O. The Insect Book, pp. 353–9.
1902. Howard, L. O. Proc. Ent. Soc. Wash., vol. 5, No. 1, p. 5.
1902. Marlatt, C. L. Circ. 50, Bur. Ent., U. S. Dept. Agric., pp. 1–8.
1902. Schaffer, C. Journ. N. Y. Ent. Soc., vol. 10, No. 4, p. 251, Dec.
1903. Packard, A. S. A textbook of entomology, New York, p. 140.
1911. Strickland, E. H. Journ. N. Y. Ent. Soc., vol. 19, No. 4, pp. 265–9, Dec.
1912. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 14, No. 2, pp. 107–8, June 19 (*Termes flavipes* Kollar).
1914. Barber, H. G. Journ. N. Y. Ent. Soc., vol. 22, No. 1, p. 73, March.
1915. Snyder, T. E. Bur. Ent. Bull. 94, pt. 2, U. S. Dept. Agric., pp. 13–85, Feb. 17 (*Leucotermes flavipes* Kollar).
1915. Hozawa, S. Journ. Col. of Sci. Tokyo Imper. Univ., vol. 35, art. 7, p. 82, April 30.
1916. ————. Grand Rapids Public Library (Mich.), 45 Ann. Rept., p. 59, April.
1916. Snyder, T. E. Bull. U. S. Dept. Agric., No. 333, pp. 1–32, Feb. 16.
1916^a. Snyder, T. E. Farmers' Bulletin, U. S. Dept. Agric., No. 759, pp. 1–20, Oct. 9.
1916. Thompson. C. B. Journ. Compar. Neurology, vol. 26, No. 5, Oct.
1917. Thompson, C. B. Journ. Morph., vol. 30, No. 1, Dec.
1918. Caudell, A. N. Can. Ent., vol. 50, No. 11, pp. 375–81, Nov.
1918. Comstock, J. M. The Wings of Insects, chap. 8, pp. 132–144.
1918. Dobson, R. J. Psyche, vol. 25, No. 5, pp. 99–101, Oct.
1919. Thompson, C. B., and Snyder, T. E. Biol. Bull., vol. 36, No. 2, pp. 115–132.
1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, pp. 379–398, June.
1920. Safford, W. E. Ann. Rept. Smithson. Institut. for 1917, pp. 377–434.

RETICULITERMES VIRGINICUS Banks.

For taxonomy see p. 46.

This species, *Reticulitermes* (*Termes*) *virginicus*, was described by Banks as late as 1907. The type localities are Falls Church and Chain Bridge, Virginia, and Washington, District of Columbia. With *R. flavipes* Kollar and *hageni* Banks, it occurs in the vicinity of Washington. It has a more limited geographical distribution than *flavipes*, occurring only in the Southern States. It has been found from Baltimore, Maryland, south to Paradise Key, Florida, in the Lower Everglades, and west to Kentucky and Louisiana. H. G. Hubbard collected *virginicus* as early as 1880 at Ocean Beach (Jupiter Narrows), Indian River, Florida, April 22, in driftwood.

This species occurs at fairly great altitudes in the Southern Appalachian Mountains, that is, the Great Smoky Mountains of Tennessee and the Black Mountains of North Carolina. As the greater altitudes are attained, termite colonies in the earth under stones are more common.

R. virginicus differs from *flavipes* in the smaller size, in certain structural details, and in the time of swarming. *R. virginicus* is subterranean in habit, and, like *flavipes*, is destructive to wood products. Apparently all of our native species of *Reticulitermes* pass through a life cycle similar to that of *flavipes*. The colonizing adults swarm about one month later than *flavipes;* after shedding the wings, they form new colonies in the ground under and in decaying wood.

SWARMING.

Reticulitermes virginicus swarms approximately one month later than *flavipes* in Maryland and Virginia and in the vicinity of Washington, District of Columbia, that is, at the end of May or early in June. The swarm usually occurs during the forenoon. At Falls Church, Virginia, on June 8, 1912, fully developed or mature nymphs of the first form of *virginicus,* with opaque wing pads, were observed to molt, after a quiescent stage. Nymphs in all stages described for *flavipes* were observed molting until June 11. On April 30, 1913, these nymphs passed through the final molt and on June 1 the swarm occurred. On April 30, 1913, nymphs of the second form were mature in colonies. On May 18, 1915, at Falls Church, nymphs of the first form of *virginicus* were mature and they passed through the final molt from May 18 to May 27. On June 5, 1915, the swarm occurred. In 1916, *virginicus* swarmed on June 12, at Falls Church and at Washington; in 1917 the swarm occurred on June 21 at Falls Church. In 1918 flying adults of *virginicus* were collected at Falls Church on June 1 in the morning and June 20 at 2 p. m.

In Washington, this termite swarmed on June 19, 1911, near Chain Bridge, and June 9, 1915 in Washington, from colonies outdoors. In an infested building at Washington, *virginicus* swarmed on April 16, 1916; and in 1916, outdoors on June 12; in 1917, on March 19, 24, and 26, also July 7 in infested buildings; in 1918 numerous adults of *virginicus* flew in a window of the third floor of the Natural History Building of the United States National Museum on June 4. In 1919, at Washington, District of Columbia, swarms occurred in infested buildings on April 7 and 9 in the afternoon. Another swarm occurred in an infested building on May 18.

At Laurel, Maryland, between Washington and Baltimore, *virginicus* swarmed on June 25, 1912. At Roanoke, Virginia, this species swarmed on March 3, 1917, in an infested building.

On March 12, 1917, *virginicus* swarmed at Paducah, Kentucky. At Memphis, Tennessee, the swarm occurred in a building on May 26, 1915. At Collins, Georgia, E. B. Griffen collected winged adults on November 20, 1917, in a telephone pole; the only autumn record.

On March 30, 1914, winged adults of this termite were found in an infested building at St. Augustine, Florida. At Homestead, Florida, the swarm occurred on March 6, 1917 (C. A. Mosier). Winged adults, mature and ready to swarm, were found in a log at Brickell Hammock, Cocoanut Grove, Florida, on March 23 (T. E. Snyder). At South Jacksonville, Florida, on April 13, 1917, the writer found adults ready to swarm in a telephone pole (white cedar) as high up as 12 feet from the ground. In 1918 *virginicus* colonies were found at Miami Beach, Florida, under dead cabbage palmetto trunks on the ground. The writer observed adults flying on April 9 at 12 m. On February 21, 1919, at Labelle, Florida, winged pigmented adults ready to swarm were found in a saw palmetto tree by F. C. Craighead. On December 30, 1918, W. E. Brown found workers damaging a post supporting a mail box at Miami Beach, Florida; these workers are probably of the species *virginicus*. Damage by species of *Reticulitermes* in southern Florida is not common, and colonies of these termites are of comparatively rare occurrence.

F. C. Bishopp, on May 3, 1916, noted a swarm of this species at Shreveport, Louisiana. He writes:

> At 5.30 this afternoon observed a tremendous flight of termites on the sunnyside (west) of a warehouse near the river. The greatest numbers were emerging from the timbers of a coal bin built against the outside of the warehouse but they were also emerging from the loading platform all along this side. These planks seem to be largely consumed by their galleries.
>
> The air in places was filled with the flying insects and places several feet square near where they were emerging were largely covered by them. In smaller patches (6 inches square) the wood was completely covered by the silvery wings. A few soldiers, yellow wingless specimens, were seen crawling among the others. I am informed that a large flight also took place last week. The planks of the loading platform on the south side are almost completely destroyed, and I am told the entire building is mined and will soon have to be reconstructed.

Phenological correlation of the first swarming of Reticulitermes virginicus Banks with the bloom of the chinquapin (Castanea pumila) at Falls Church, Virginia.

First swarming.	First full bloom.
1912.	1912. June 7.
1913. June 1.	1913. June 2.
1914.	1914. June 10.
1915. June 5.	1915. June 4.
1916. June 12.	1916. June 11.
1917. June 21.	1917. June 12 (first flowers out).
1918. June 1.	1918.
1919. June 7.	1919. June 5.

R. virginicus possesses the three different reproductive forms as does *flavipes*. Besides the normal colonizing forms, both the second form type with short wing pads and the apterous type or third form occur in colonies. This latter type is apparently rare. On June 4, 1915, at Falls Church, Virginia, a portion of a colony of *virginicus* was removed to a rearing cage, at the time the winged adults were ready to swarm. On August 20 reproductive individuals of the second form were appearing. These forms had the characteristic pale yellow pigmentation.

The young colonies are of small size and the rate of increase is but slow. Colonies have been reared as in case of *flavipes* (Snyder, 1915) and the development of the young observed.

On May 18, 1915, at Falls Church, Virginia, mature nymphs of the first form and those in quiescent stages, also sexual adults attaining wings and mature pigmentation, were placed in rearing.

June 5, 1915. Sexual adults swarmed.

June 25, 1915. First eggs in royal cells in wood.

Middle July, 1915. Egg laying completed.

August 4, 1915. Eggs not yet all hatched, nymphs in various stages of development. Abdomens of queens not markedly distended; males in royal cells with females.

December 3, 1915. Workers and soldiers attaining maturity.

January 8, 1916. Same.

February 9, 1916. Workers and soldiers nearly mature; workers, 3 mm. in length; soldiers, 4 mm. in length. Eggs in clusters in galleries over 1 dozen. Eggs ¾ mm. in length and nearly ½ mm. in width; vary in size. Many workers with mutilated antennae. Reproductive forms active; antennae mutilated with abdomens of queens not markedly distended or the segments as yet separated.

February 17, 1916. Eggs as yet unhatched since February 9, '16. No recently hatched nymphs; only about one-half dozen eggs observed.

March 2, 1916. Two recently hatched nymphs and six unhatched eggs in nest; eggs in cluster and active young nymphs near eggs.

March 15, 1916. Two unhatched eggs and two recently hatched young observed in nest; nymphs near eggs.

April 5, 1916. Eggs all hatched; nymphs in various stages from recently hatched to twice this size, workers 3½ mm., soldiers 4½ mm.; workers and soldiers 13 segments to antennae; mature.

June 6, 1916. Worker 3½ mm. in length, mature; soldier 3½ mm. in length.

References to biological or economic literature.

1915. Snyder, T. E. Bur. Ent. Bull. 94, pt. 2, U. S. Dept. Agric., pp. 13–85, Feb. 17.
1916. Snyder, T. E. Bull. 333, U. S. Dept. Agric., pp. 1–32, Feb. 16.
1916^{a}. Snyder, T. E. Farmers' Bull. U. S. Dept. Agric. No. 759, pp. 1–20, Oct. 9.
1916. Thompson, C. B. Journ. Compar. Neurology, vol. 26, No. 5, Oct.
1917. Thompson, C. B. Journ. Morph., vol. 30, No. 1, Dec.
1919. Thompson, C. B., and Snyder, T. E. Biol. Bull., vol. 36, No. 2, pp. 115–132.
1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, pp. 379–398, June.

RETICULITERMES HAGENI Banks.

For taxonomy see pp. 44–45.

It seems rather strange and unusual that a new species of termite should be found occurring in the District of Columbia and its vicinity at this late date. Yet this is the second new species since 1907, when Mr. Banks described *R. virginicus* from Virginia and the District of Columbia. *R. hageni* is similar to *virginicus* but is of a pale brown color and swarms later in the season. It was named in honor of the distinguished entomologist, Dr. H. Hagen.

Winged pigmented adults of this termite were first found by the writer on July 24, 1911, in the bases of telegraph poles at Kane (Greene County), Illinois.

R. hageni has been found from the vicinity of Washington, District of Columbia, south to Florida (Osten Sacken). Winged adults are in the Museum of Comparative Zoology at Cambridge, Massachusetts, which were collected at Charleston, South Carolina. It is a southern species, not being found farther north than southern Maryland, but occurs as far west as Illinois and Texas.

SWARMING.

R. hageni is a species which swarms late in the season. As stated, the writer found a few winged adults in a colony in the base of a white cedar telegraph pole at Kane, Illinois, as late as July 24, 1911. Apparently most of the colonizing adults had swarmed. On August 9, 1912, the writer found a few scattering adults flying at Washington, District of Columbia. On August 11, 1913, Wm. Middleton collected a large number of swarming winged adults and a few soldiers from a colony in a small chestnut corner stake at Falls Church, Virginia. The colony, which was not large, swarmed at 12.30 p. m. On August 17, 1913, the writer again collected winged adults at Chain Bridge, Virginia.

At Richmond, Virginia, on August 11, 1916, E. W. Trafford found winged adults in the base of a chestnut telegraph pole. On August 17, 1916, N. Banks collected a few flying adults at Great Falls, Virginia.

On September 1, 1917, at the corner of Corby's and Bennings' Roads, District of Columbia, A. F. McDermott collected an Asilid fly feeding on winged sexual adults of this termite, which was swarming in large numbers. The fly is *Holcocephala abdominalis.*

Osten Sacken found adults in Florida in March, 1858; the label on other winged adults is Jacksonville, Florida, April 29.

H. S. Barber found adults flying on June 9, 1905, at Lake Drummond, Dismal Swamp, Virginia. On October 30, 1918, Barber found a pair of deälated adults in a cell under a log near Harrisburg, Texas. They apparently represent a variety.

This termite is similar in habits to others in the genus *Reticulitermes.* It has been found destructive to telegraph poles, corner stakes, and other wood in contact with the ground.

Reference to biological or economic literature.

1915. Snyder, T. E. Bur. Ent. Bull. 94, pt. 2, p. 73, U. S. Dept. Agric., Feb. 17, (*Leucotermes virginicus* Banks).

RETICULITERMES CLARIPENNIS Banks.

For taxonomy see p. 47.

This termite is the species that has most commonly been considered to be *R. lucifugus* Rossi, the species occurring in Mediterranean Europe.

R. claripennis Banks occurs in the United States from Kansas south to Brownsville, Texas, west to Austin (Travis County) and Uvalde, Texas, and east to Beaumont (Jefferson County), Texas.

H. G. Hubbard, on May 1, 1897, found a few workers and soldiers of *R. claripennis* in a stick buried in sand near a dry wash ("Rillito"), near Tucson, Arizona. This is the dry river bed passing Tucson, about 4 to 5 miles north of the town. It also occurs in Monterey, Mexico.

This termite has habits similar to other species of *Reticulitermes.* It is destructive to telephone poles and the woodwork of buildings, such damage in the vicinity of Brownsville and San Benito, Texas, being severe. Several damaged buildings were examined by the writer in April, 1917.

SWARMING.

R. claripennis normally swarms in the spring of the year, although winged adults have been found in colonies in the fall of the year. E. A. Schwarz found adults of this species swarming at San Diego, Texas, on October 25, 1895; other records are Dallas, Texas, April 1, 1907 (Pratt), and April 5, 1907 (Cushman); Beaumont, Texas, March 19, 1908 (Tucker); at San Benito, Texas, 20 miles northwest of Brownsville, the owner of an infested building stated to the writer on April 25, 1917, that the termites swarmed three times in the fall of 1916 within a few weeks, just as cold weather set in; Uvalde, Texas, swarming on March 14, 1917 (Parman), from near a hotbed in a garden.

On April 21, 1916, H. Yuasa found sexual adults swarming in the basement of a building at Manhattan, Kansas.

Winged adults were collected in Monterey, Mexico, September 28, 1913 (Crawford).

R. claripennis Banks has reproductive forms similar to those that occur in colonies of *R. flavipes* Kollar and other termites in this genus.

On April 24, 1917, along the Rio Grande River on a moist wooded bank below Fort Brown, Brownsville, Texas, the writer found a colony of *claripennis* in the moist and decaying wood of an uprooted stump partially buried in the ground. Hollow places in the log had been filled in with clay and the insects had projected galleries through the clay. Seventeen reproductive forms were found in this large colony, 16 large queens of the second form (with short wing pads), with distended abdomens, and one male or king of the first form (with wing stubs). The largest of the queens was 9½ mm. in length, measured after preserving in alcohol. The abdomen of the king was slightly distended and he was fully as old as the queens. It is very unusual to find reproductive individuals of two different forms in the same colony. Eggs and recently hatched young were abundant in galleries and chambers in the wood and clay.

RETICULITERMES TIBIALIS Banks.

For taxonomy see pp. 47–50.

Reticulitermes tibialis is distinct from either *flavipes* Kollar or *lucifugus* Rossi, both in structure and biology. The tibiae of the winged adults are blackened and the soldier has a broad gula. This is a very widely distributed species throughout the western United States, occurring from as far east as Iowa and Arkansas, west to the Pacific Coast and south to Brownsville, Texas. The localities from which it was first recognized as a distinct species were in the Pikes Peak region, Colorado Springs, Garden of the Gods, Ivywild, and Manitou, Colorado; W. D. Edmonston and A. B. Champlain collecting the first specimens in 1915. The species was later collected by B. T. Harvey and George Hofer, Harvey supplying biological notes.

Baron R. Osten Sacken (1877) stated that "at Manitou, Colo., August 19, I saw a small *Termes* flying (perhaps a different species) and observed similar, already wingless, couple on the ground." This species was without doubt *tibialis*, since no other termite has been found in this region. Mr. Banks has recently examined these specimens and they are *tibialis*.

Later, however, it was also determined that E. A. Schwarz had collected this termite at Beeville, Texas, as early as November 1, 1895; the winged adults were swarming at that date.

On June 20, 1915, Harvey made general observations on this species in the vicinity of Colorado Springs. He states that this termite occurs mostly in and about towns, along prairie borders and in low foothills, sometimes running up canyons and streams. Old fence posts are often damaged, but Harvey was unable to find any cases of damage to timbers in buildings.

This termite occurs up to a high elevation on the mountains of Colorado. Harvey stated, on August 4, 1915, that the highest altitude at which he collected specimens was 7,000 feet, at Manitou, Colorado, in scrub white oak and under stones. He further stated that it very likely may occur higher up to about 8,500 feet, the approximate upper limit of scrub white oak thickets in this region. (Observations by the writer in the Pikes Peak region in July, 1917, indicate that 7,000 feet is probably the highest limit at which colonies are found.)

One small colony, at Ivywild, Colorado, consisting of but few workers and soldiers, was found under a pile of old horse manure which had been deposited on top of a sunken granite boulder which was practically covered by dirt and grass. Many larger colonies were in scrub white oak thickets 10 to 20 yards away.

On May 24, 1915, Harvey made the following notes at Colorado Springs: Many colonies occurred under old, dried "cow chips" or dung in a northerly pocket of open mesa land covered sparingly with Yucca, bunch grass, mountain mahogany, etc. Small dark red ants occupied the "cow chips" along with the termites.

Only "cow chips" firmly cemented to the ground and 2 or 3 inches thick with weeds and plants growing up through them contained termite colonies. The termites occupied the lower side of the "cow chips," which were moist. The ants occupied the upper portions, which were dry. The ants also occupied the thinner edges of the "cow chips," which were also dry. Many termites were found on the moist ground under the "cow chips" and their tunnels entered the earth below.

Apparently this species has habits similar to other *Reticulitermes;* that is, it excavates subterranean tunnels and is essentially wood-destroying, but does not injure the woodwork of buildings in the vicinity of Colorado Springs, El Paso County, Colorado.

M. Chrisman collected workers and soldiers of *tibialis* on August 22, 1914, in Bear Canyon, Santa Catalina Mountains, Arizona, at the surface of a soil gallery in the sapwood of a small dead black oak tree.

SWARMING.

E. O. Essig collected winged adults of this termite swarming on January 5, 1916, at Sanger, California, near Presidio; at Provo, Utah, March, 1875 (Spaulding). In Colorado, *R. tibialis* has been found swarming in the spring and fall. Osten Sacken (1877) collected adults flying at Manitou, Colorado, on August 19. At Colorado Springs, Colorado, A. B. Champlain found adults swarming and crawling on the sidewalk, at 10 a. m., on March 24, 1915, elevation 6,000 feet. On April 8, 1915, George Hofer, A. B. Champlain and W. D. Edmonston again found sexual adults of this species:

> Stragglers, wingless specimens taken on sidewalk for a distance of 1 mile. Finally we found a hole between two large flagstones on sidewalk; here we found winged, wingless, and one light-colored individual. We could not dig them out as the stones were too close and heavy.

On April 10, B. T. Harvey also collected winged adults. The day was bright and warm and the swarm emerged from 11 a. m. to 1 p. m. It had rained the day before. As late as April 19, Harvey found adults emerging from the ground, at an altitude of 6,075 feet above the sea level.

Winged adults of this species have been found at Colorado Springs, Colorado, in the autumn. On September 9, 1917, Messrs. Edmonston, Hofer, and Craighead found these winged adults ready to swarm on a side hill near the entrance to the canyon at the mouth of Ute Pass. Workers and soldiers were crawling about on the ground in the center of the trail into the bright sunlight.

In Arizona, Barber and Schwarz collected winged adults at Williams "29/7."

At Lincoln, Nebraska, winged adults have been found in April and September.

In Kansas, *R. tibialis* has been found swarming in September (2 and 11), at Manhattan (F. A. Marlatt).

In Texas, winged adults have been collected flying at Beeville, November 1, 1895 (Schwarz); Uvalde, May 7, 1917 (Snyder); Dallas, December 16, 1910 (Pinkus), during fair and warm weather after a recent rain; Plano, October (Tucker); and December 19, 1917, at Victoria (Mitchell). Mitchell's notes on this swarm are:

> White ants emerging by thousands from crevice in concrete sidewalk on Santa Rosa Street, Victoria, Texas, December 19, 1917. 1917 has been very dry the entire year. October and November have been unusually cold, freezing and frosting many times. December 19 was a moderately warm day. The ants took wing as soon as they reached the edge of the sidewalk. A few soldiers and workers were around the exit crevice and seemed to be directing the winged ants to go in the same direction.

At Uvalde, Texas, the writer found this species swarming on May 7, 1917, in moist bottom land along the Leona River. The swarm occurred before 1.30 p. m., when flying adults were observed. On May 3 the temperature at Uvalde had been 97° F., with a humidity of 40° to 50° (low barometer). On the 5th there were high winds, hail, and heavy rain, which was continued in the morning of the 6th, being markedly cool on the 6th and 7th. After this hot weather on the 3d and the rain on the 5th, termites (*R. tibialis* Banks) were ready to swarm, which occurred on the 7th.

In southwestern Texas termites usually swarm after rainfall, when the ground is in better condition for the establishment of colonies.

At Ponca City, Oklahoma, this termite was found injuring the roots of a privet hedge on August 11, 1916, by Mr. A. Jackson. He was successful in getting rid of the termites by the liberal use of water around the roots, plowing a furrow with a cultivator on either side of the hedge and running water in the furrows.

Reproductive forms have been found by Harvey and Champlain. On July 16, 1915, B. T. Harvey noted reproductive forms in a colony which proved to be three females and two males of the type with wing pads (second form). These were in a colony in a scrub white oak root collected on April 26 in the Garden of the Gods and removed to Colorado Springs for observation. These forms quite probably developed between April 26 and July 16, since the root was removed. (Pl. 30.)

A. B. Champlain, on April 12, 1915, at the Garden of the Gods, Colorado, found a small colony under a stone, which consisted of workers, soldiers, and a small apterous queen of the third form ("ergatoid"). This queen has the chitinized parts of a grey pigmentation, is 5½ mm. in length, and has 16 segments to one antenna, the other being mutilated. There are no abdominal appendices present.

A male of the third form was found in a very large colony of *R. tibialis* collected by B. T. Harvey at Colorado Springs, Colorado, on April 16, 17, and 19, 1915. This colony was in an old decayed cottonwood stump, the roots, and subterranean galleries. Indications are that the colony had its annual swarm in March or April, according to Harvey. The colony included 5,463 workers, 115 soldiers, 164 nymphs of the reproductive forms, and 297 young. Harvey estimates that probably 95 per cent of the colony was collected. The young third form male had stylets and ventral abdominal segments (sternites) 8 as in male; in the female there are 6 and the sixth is broad; body and head markedly pigmented dark grey. Length approximately 5 mm. (one should only approximate the measurements of a specimen preserved in alcohol). There are no traces of wing buds, but there are slight traces of eyes. Antennae with 16 to 17 segments. The pubescence is long and dense, as in reproductive forms. This form is mature and very probably matured at the same time as the winged adults and nymphs of the second form.

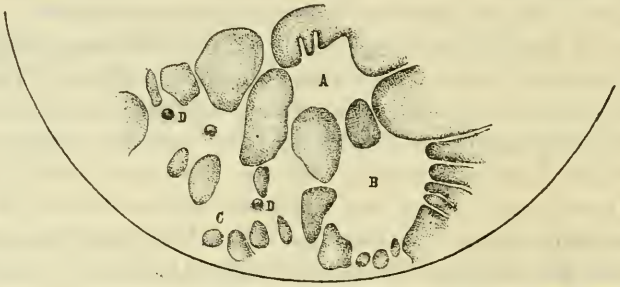

FIG. 70.—RETICULITERMES TIBIALIS. DIAGRAM OF A PORTION OF AN ARTIFICIAL NEST IN A GLASS JAR; NATURAL SIZE. *A* AND *B*. "ROYAL CELLS" INHABITED BY 2 KINGS AND 3 QUEENS; SECOND FORM REPRODUCTIVE INDIVIDUALS. WORKERS ATTENDING QUEENS AND SOLDIERS GUARDING ENTRANCES. THE MANDIBLES ARE POINTED TOWARD THE ENTRANCES WHICH ARE NO LARGER IN DIAMETER THAN THE WIDTH OF THE ABDOMEN OF A TERMITE. *C*. CELL CONTAINING EGGS IN LARGE CLUSTER AND RECENTLY HATCHED YOUNG ATTENDED BY WORKERS. *D*. EXIT HOLES THROUGH THE SAND TO THE WOOD ABOVE.

This colony and a similar one of *Neotermes castaneus* Burmeister kept alive for 17 years by the Rev. F. L. Odenbach have already been discussed (Thompson and Snyder, 1919).

On August 2, 1915, a small colony of *Reticulitermes tibialis* Banks was collected in a stub of a dead scrub white oak, by B. T. Harvey, at Ivywild, Colorado, and sent to the writer in Washington. The insects, mostly in the wood, were placed in a glass jar filled with moist sand. A labyrinth of galleries was constructed through the sand and the insects could be observed through the bottom of the jar. This colony consisted of workers, soldiers, and nymphs (young). On November 22, 1915, three females and two males—second form reproductive types—were present in this colony; these forms had probably developed since the colony was removed. The females had markedly distended abdomens and the males slightly distended abdomens. Both sexes had greyish-brown or straw-colored pigmentation to the chitinized parts. The reproductive forms usually inhabited cells in the sand at the bottom of the jar, where they were easily observed (fig. 70). When there were unfavorable conditions of temperature or moisture they retreated into the wood. On March 13, 1916, a cluster of about 1 dozen eggs was observed.

Some data on the rate of egg laying of these three reproductive females of the second form in an artificial colony indoors is at hand; the following notes on this colony have been greatly condensed:

April 27, 1916. Numerous eggs in cluster.
May 10. 1 large and 1 small cluster of eggs.
May 31. A large number of eggs.
June 28. Numerous eggs and recently hatched young.
July 20. Eggs and young.
August 16. Numerous eggs.
August 23. Recently hatched young and eggs.
August 29. Recently hatched young and eggs, both numerous.
September 6. Eggs and young.
September 22. Eggs and young.
October 20. Few eggs and young.
November 14. Recently hatched young.
December 4. Small cluster of eggs.
December 9. Young.
December 12. 2 clusters of eggs.
December 20. A cluster of eggs half the size of a pea.
December 27. Young, few eggs.
December 28. Numerous eggs.
January 3, 1917. Eggs.
January 5. Numerous eggs.
January 9. Recently hatched young, several dozen eggs.
January 16. 3 clusters of eggs the size of peas and recently hatched young.
January 18. Large cluster of eggs and recently hatched young.
January 25. Two large and one small cluster eggs, also young.
January 29. Recently hatched young, large cluster eggs size three peas.
Febuary 3. Fewer eggs.
February 8. Large cluster of eggs and recently hatched young.
February 10. Recently hatched young.
February 21. Eggs and young.
March 2. Eggs and young; 2 clusters of eggs size of peas.
March 6. Small clusters of eggs.
August 14. Cluster of eggs.
September 12. Young.
October 10. Eggs and recently hatched young.
November 1. Recently hatched young.
December 7. Eggs.
December 24. Recently hatched young and eggs.

December 31. Large batch of eggs and recently hatched young.
January 3, 1918. Large cluster of eggs.
January 21. Large cluster of eggs and recently hatched young.
February 19. Eggs and recently hatched young.
December 2. Eggs and young.

Since then, while numerous eggs and young have been found every month of the year in this artificial colony maintained indoors, no forms with wing pads or wings have developed up to May 1919, after nearly four years of breeding. The colony is increasing in numbers and is healthy.

The egg is white, reniform, and approximately 0.68 mm. in length.

References to biological or economic literature.

1877. Osten Sacken, C. R. Proc. Bost. Soc. Nat. Hist., vol. 19, pp. 72–73 (for Jan. 3, 1877), June (*Termes*, species.).

1898. Osborn, H. Proc. Iowa Acad. Sci., vol. 5 (for 1897), p. 231 (*Termes flavipes* Kollar).

1916*a*. Snyder, T. E. Farmers' Bull. No. 759, U. S. Dept. Agric., Oct. 9, p. 6, fig. 6 (*Leucotermes lucifugus* Rossi).

RETICULITERMES HESPERUS Banks.

For taxonomy see pp. 50–51.

This species is apparently restricted to Washington, Oregon, California, and Nevada. It is distributed over a wide area in the Pacific Coast region, occurring from Spokane and Wenass Valley, Washington (Henshaw), south to Campo and San Diego, California (Snyder), on the border of Lower California and the United States, and east to Elko, Nevada. It does not occur east of the general region of the Sierra Nevada Mountains and the Great Basin.

The long-headed soldier of this termite is distinctive. However, there is a difference in the length of the heads of soldiers of *R. hesperus* from different colonies, some being long-headed and others short-headed. These differences correspond to the round-headed and flat-headed soldiers of *K. schwarzi* Banks, and *K. jouteli* Banks, from the same colony. Indeed, it might be said that these species have two types of soldiers.

This species has been found at other localities as follows:

Oregon: The Dalles, Wasco County (Henshaw); Keno, Klamath County (in the roots of sage brush, Snyder); and Ashland, Jackson County (Snyder).

California: McCloud, Siskiyou County; Samoa, Humboldt County (H. S. Barber); The Geysers, Sonoma County (Osten Sacken); Placerville, Eldorado County (J. J. Sullivan); San Francisco, Golden Gate Park (Snyder); Alameda County (winged adults), November; Los Gatos; Mountain View (winged adults, Ehrhorn); Palo Alto; San Jose (Feb., 1872, I. Bush, winged adults), also San Jose (Dec. 7, 1881, Bush, swarming)—all in Santa Clara County; Del Monte, in Monterey County (Snyder); Little Bear Lake, San Bernardino

Mountains (winged adults, Snyder); Santa Barbara (Osten Sacken); Los Angeles (Crotch), Santa Monica, San Gabriel Mountains, and Whittier, all in Los Angeles County; Laguna Beach, Orange County (Wheeler); Campo, San Diego County (Snyder), and San Diego (Mar. 25, 1916, H. G. Dyar, winged adults).

R. Hopping collected workers and soldiers from a large colony under lava rock, near Mount Lassen, California, along the Susan River, April 15, 1916. This was on a bare hillside near pine timber, with sage brush on the hill.

At San Diego, California, on July 15, 1919, F. P. Keen collected workers and soldiers of *R. hesperus* in a rather unusual location. Keen writes:

> Our soil here in San Diego has about two feet of surface soil and then a layer of sandstone conglomerate or "hardpan," about a foot in thickness, which is as hard as concrete and practically impervious to roots, air or moisture.
>
> While excavating a garage pit, and after penetrating a foot of thick "hardpan," I was most surprised to find little pockets of these termites. I did not find their galleries, although they probably were there. How they ever managed to get below the "hardpan" (three feet below the surface) is a mystery to me. They couldn't have followed roots down because roots don't penetrate it, and they couldn't have gone around since it extends as a solid layer all over the mesa lands. Above ground I have found them in honeysuckle roots and other things.

In Southwestern Texas galleries of species of termites of subterranean habit penetrate soil which is dry and baked hard by the sun. Possibly most of the excavating is done during the rainy season when the earth is moist.

H. O. Marsh collected workers and soldiers at Avalon, Catalina Island, California, on October 28, 1908.

Nevada: Elko (in the roots of sage brush, Snyder). (Pl. 14, fig. 2.)

R. hesperus is a destructive wood borer and injures any wood in contact with the ground, including telephone poles and the woodwork of buildings. (Pl. 31.) It has similar habits to other species in the genus *Reticulitermes*. On May 22, 1918, Mr. L. A. Whitney, quarantine inspector of the State Commission of Horticulture, San Francisco, submitted specimens of workers and soldiers of this species for determination. They were injuring artichoke plants.

Species of *Reticulitermes* in eastern United States are seldom if ever found under cow chips; in California, colonies under cow chips and stones are not rare.

The study of the habitat of the different genera of termites with ecological notes and the plotting of their distribution in life zones will be of great interest when more is known of their habits.

SWARMING.

Specimens of winged colonizing adults in the collection of the Museum of Comparative Zoology, at Cambridge, Massachusetts, bear the label, "Los Angeles, California, May, '73, G. R. Crotch."

Osten Sacken (1877), as early as 1877, noted a species of termite swarming at Geysers, Sonoma County, California, which proves to be this species:

> The smaller species of *Termes* I observed on the wing at the Geysers, Sonoma County, May 6. Seeing the air filled with them about the hotel, I soon found a plank on the ground, from under which they were emerging, coming from under ground. As the spot was in the yard of the hotel, I could not well dig very deep in the soil. At the same time I noticed a number of individuals on the soil, which had already shed their wings and were running about in couples. One of the individuals forming these couples looked a little longer and more pubescent at the end of the abdomen than the other; thus inducing the belief that those were the two sexes. I watched these couples for some time, running one after the other very seduously, but I never saw them copulate. About this time I was called to dinner and saw similar couples running about on the tablecloth. I secured several such couples, both in alcohol and on pins. I never saw the *Termopsis* run about in couples in that way.

I. Bush collected winged adults of this species at San Jose, California, in February, 1872, and A. E. Bush on November 16 and December 7, 1881. Other winged specimens in the collection of the United States National Museum bear the labels, "Alameda Co., Cal., Nov." and "March 25, '16, H. G. Dyar."

On May 29, 1917, adults swarmed at Los Angeles, California. On June 1, 1917, the writer found this termite flying at elevations of 4,000 to 4,500 feet in the San Bernardino Mountains, California; apple trees were in full bloom. At Little Bear Lake, elevation approximately 5,000 feet, the adults were in colonies ready to swarm under dry cow dung in a small canyon leading to the lake. The western flowering dogwood (*Cornus nuttallii*) was in full blossom and had the pollen ripe. Nymphs of the second form were also present in this colony.

Reference to biological or economic literature.

1877. Osten Sacken, C. R. Proc. Bost. Soc. Nat. Hist., vol. 19, pp. 72–3 (for Jan. 3, 1877), June (*Termes*, species).

RETICULITERMES LUCIFUGUS Rossi.

Rossi described "*Termes*" *lucifugus* in 1792; the type locality is the shores of the Mediterranean. This termite occurs in all the Mediterranean countries of Europe and also in western France and Hungary, but is especially abundant throughout southeastern Europe and causes at times considerable damage. Hagen (1858) and Jacobson (1904) record the distribution of *lucifugus* in detail.

Previous to 1797 it never attracted any attention; nor is the occurrence of a termite in Europe ever mentioned by the older authors. It was not until 1840 to 1850 that *lucifugus* was reported to have committed any noticeable depredations. Early in this year (1853) this species appeared as a regular pest throughout the city of Rochelle, France (Quatrefages, 1853). Boffinet (1853) has described the destructive habits and omnivorous tastes of *lucifugus*.

Reticulitermes lucifugus, like all the other species in this genus, is subterranean in habit and is destructive to wood. Lespès (1856), Fritz Müller (1873 and 1875), Perris (1876), Grassi (1893), Pérez (1894), Feytaud (1912), and many others have studied this termite in Europe.

Mr. Banks has found differences between the European *R. lucifugus* Rossi and *R. claripennis*; but he considers it unlikely that *lucifugus* should occur in the central west of the United States. While *R. claripennis* Banks has often been confused with *lucifugus*, the species *hesperus* Banks is more nearly related, especially in colonies where the long-headed soldier form is absent. In this event both winged adults and soldiers are very similar. This termite has, however, been found at Stony Brook and other localities near Forest Hills, Massachusetts, by R. J. Dobson. Mr. Banks states that it is very close to *R. hesperus*, with wings fully as dark or darker (probably specimens that have flown will be darker). The ocelli are as in *claripennis*, but the wings are much darker. Mr. Banks says that he has no doubt but what it has been introduced from southern Europe, possibly in dirt about trees for the Arnold Arboretum at Forest Hills, Massachusetts.

Kellogg in his American Insects (1908) records a specific instance where *lucifugus* has been introduced into the United States from Europe. He writes:

> The spread of termites from one continent to another, as in the case of *Termes flavipes* from America to Europe, and *Termes lucifugus* from Europe to America, can be easily explained by involuntary migration in ships. In unpacking several cases of chemicals received from Germany at Stanford University, scores of termites were exposed when the wooden boxes were broken up. The insects, mining in the wood of the boxes, had protection, food, and free transportation on their long ocean journey from Hamburg around Cape Horn to California.

It is not known whether or not this termite is established in California.

SWARMING.

According to Dobson, *R. lucifugus* probably swarms about one month later than *flavipes* in the vicinity of Boston, Massachusetts.

Winged adults collected in colonies or flying in June and July; no swarm has yet been observed. Dobson has worked on the biology of *R. flavipes* and *lucifugus* in this vicinity and found an enlarged first form queen of *lucifugus*.

Hagen (1858) cites records which show that in Europe *lucifugus* swarms in both the spring (April) and fall (October).

Dobson (1918) finds differences in the seasonal activity of *flavipes* from those the writer has recorded in Virginia.

According to Hagen (1858) the egg is 0.65 to 0.7 mm. in length.

References to taxonomic, biological, or economic literature.

1840. Blanchard, E. Hist. Nât. des Insectes, Paris, p. 47, (*Termes lucifugum.*)

1843. Bobe Moreau, Mém. sur. les termites observés à Rochefort, etc.

1849. Joly, N. Mém. Acad. Sc. Toulouse, ser 3, vol. 5, pp. 1–31, 3 pls.

1853. Quatrefages, Ann. Sci. Nat., sér. 3, Zool. vol. 20, pp. 16–21.

1853. Boffinet, Ann. Soc. Linn. Bordeaux, ser. 2, vol. 9, pp. 145–157.

1856. Lespès, C. Ann. Sci. Nat. Zool., sér. 4, vol. 5, pp. 227–282, pls. 5–7 (*termite lucifuge*).

1858. Hagen, H. A. Linn. Ent., vol. 22 (*Termes lucifugus* Rossi), pp. 178–179.

1873. Fritz Müller. Jenaische Ztschr., vol. 7, Heft 4, pp. 451–463, figs. 3, Nov. 18.

1875. Fritz Müller. Jenaische Ztschr., vol. 9, (new ser., vol. 2), pp. 241–264, pls. 10–13, Mai 8.

1876. Perris, E. Ann. Soc. Ent. France, sér. 5, vol. 7, pp. 201–202.

1893. Grassi, B., and Sandias, A. Dagli Atti dell' Accad. Gioenia di sci. nat. in Catania, vol. 6 and 7, ser. 4 (pp. 1–150 of author's separate).

1894. Pérez, J. Comp. Rendu Acad. Sci. Paris, vol. 119, No. 19, pp. 804–6, Nov. 5.

1904. Jacobson, G. Zool. de l'Acad. imp. des. sci., vol. 9, pp. 57–107. St. Petersburg.

1908. Kellogg, V. L. American Insects, chap. 7, New York, p. 108.

1912. Feytaud, J. Arch. Anat. Micros., vol. 13, fasc. 4, pp. 481–606, figs. 34, 30 juin.

1918. Dobson, R. J. Psyche, vol. 25, No. 5, pp. 99–101, Oct.

RETICULITERMES HUMILIS Banks.

For taxonomy see pp. 51–53.

This termite has been found only in Arizona from localities near the Mexican border to as far north as Flagstaff and Williams, in Coconino County. It is a destructive wood borer and found by the writer to honeycomb the hardest wood of oak stumps, "Palo Verde," and the woody roots and stems of the bush cacti (*Opuntia fulgida, spinosier* and *versicolor*).

H. G. Hubbard found *R. humilis* in the Santa Rita Mountains as long ago as May 20, 1898. The colony was under a stone in Madera Canyon. To quote from Hubbard's note from his field diary:

> We ascended a ravine filled with majestic sycamore trees under which the ground was wet with numerous springs, but entirely tramped by cattle and devoid of smaller vegetation. * * * I found under a stone in a little dry mound in a wet spring spot, on the mountain side, a colony of true *Termes*, among which, in a cell cavity just beneath the stone was a single matured gravid female, or queen, which certainly had been winged; took eggs, larvæ, workers, and soldiers with the queen. This is the first instance known of a true queen in the genus *Termes*. There were no supplementary or nymphal queens in this colony and no male was found. I explored the entire colony, which was not a large one.

This is the first "true" queen (of the first form) found in the genus *Reticulitermes* in the United States (Schwarz, 1901). The writer referred to this queen as *R. lucifugus* Rossi (Snyder, 1915).

Prof. W. M. Wheeler found a first-form queen of *humilis* in Post Canyon, Pinaleno Mountains, Arizona, at an elevation of 4,000 to 5,000 feet, on July 17, 1917. This queen was 13 mm. in length and 2½ mm. in width (measured after preservation in alcohol) and the abdomen was distended with the segments markedly separated. There are 12 segments to the antennae.

M. Chrisman found a small colony of workers and soldiers of *R. humilis* in Bear Canyon, Santa Catalina Mountains, Arizona, on August 6, 1913, in a small, standing dead Chihuahua pine.

This termite occurs at high elevations in the Santa Rita and Pinaleno Mountains, reaching as high as 5,000 to 8,000 feet in the Santa Ritas (rather indefinite), and 5,000 to 6,000 feet (Post Canyon) in the Pinaleno Mountains (Wheeler). In the Santa Catalinas the writer found this termite in Sabino Canyon but could not find it or its work at Soldiers' Camp on Mount Lemon, in May, 1917 (elevation 7,700 feet)—timber, white pine, Douglas fir, fir, and spruce—or even in lower stands of yellow pine at 7,000 feet and lower.

Near Nogales, where the vegetation differs from that near Sabino Canyon—that is, giant cactus, and (*Opuntia*), "Palo Verde," mescal or *Agave*, Spanish bayonet or Yucca, and ocotillo (*Fouquieria splendens*), etc.—the writer found this termite in Calabasis Canyon (15 miles west of Nogales) on May 20, 1917, in the hard wood of oak stumps and logs. It also occurred in Potrero Canyon. The foothills are bare, sand, rock, and gravel. The mountain canyons contain oak, mesquite, walnut (rare), catclaw (*Mimosa*), and desert willow (*Chilopsis linearis*). Along the Santa Cruz River, willow, sycamore, and cottonwood trees are found.

George Hofer found this termite on February 3, 1917, damaging the beams of an adobe building at Alamo Ranch, near Sabino Canyon, Santa Catalina Mountains. The workers constructed their earth-like tubes up over the adobe walls to Douglas fir roof joists and bearing These covered passageways or tunnels were on the inner surface of the adobe walls. There was only a single passageway to each section of wood. The walls of these tunnels were of paper-like thickness.

Prof. W. M. Wheeler collected this termite at Oracle (Pinal County), Arizona, on March 13, 1919, and in Grant Canyon (Graham County), on March 21, 1919.

SWARMING.

R. humilis swarms during the last of June or July. The following labels are on winged adults of this species: Palmerlee, July, C. P. Biederman; Santa Rita Mountains, elevation 5,000 to 8,000 feet, June, F. H. Snow; Santa Rita Mountains, June 20, H. G. Hubbard; Fort Grant, Arizona, " '19/7", H. G. Hubbard.

References to biological or economic literature.

1901. Howard, L. O. The Insect Book, p. 356 (*Termes flavipes* Kollar?).

1901. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 4, No. 4, p. 347, Jan. meeting (1889) (*Termes*, new species).

1915. Snyder, T. E. Bur. Ent. Bull. 94, pt. 2, pp. 57–8, Feb. 17 (*Leucotermes lucifugus* Rossi).

RETICULITERMES HUMILIS, var. HOFERI Banks.

For taxonomy see p. 53.

This variety of *R. humilis* Banks was established by Mr. Banks for specimens from Sabino Canyon, Santa Catalina Mountains, and Nogales, Arizona. They are different from specimens of *humilis* from Post Canyon, Pinaleno Mountains, Flagstaff, and other specimens from the Santa Catalina Mountains, Arizona. This termite was named after George Hofer, who has been active in collecting termites.

The writer found workers and soldiers in Sabino Canyon on May 17, 1917, in the dead stem of cactus (*Opuntia spinosier*). In Calabasis Canyon, near Nogales, on May 20, the writer found workers and soldiers in the dry, hard, moist wood of an oak stump. (Pl. 32). On February 14, 1918, George Hofer found workers, soldiers, and nymphs with short wing pads in the stem of a dead cactus (*Opuntia*) in Sabino Canyon. Hofer again found workers and soldiers of this termite honeycombing the root of a living bush of *Cassia coresii*, on August 21, 1918, in Sabino Canyon. The wood was spotted with excrement.

On March 20, 1919, Hofer found a colony on Rock Creek, in Sabino Canyon, at an altitude of 4,000 feet, between the bark and wood and from the heartwood of the stump of a dead tree (*Garrya wrightii*).

RETICULITERMES TUMICEPS Banks.

For taxonomy see p. 53.

A colony of *R. tumiceps* was found by Prof. W. M. Wheeler on July 27, 1917, at Stratton in the Santa Catalina Mountains, Arizona, elevation 6,000 to 7,000 feet. Only workers and soldiers were in this colony, but Mr. Banks recognized that it was a new species from the soldier caste.[1]

Subfamily TERMITINAE Banks.

Genus AMITERMES Silvestri.

The genus *Amitermes* includes a very interesting species (*A. meridionalis* Froggatt) of Australia, which constructs the remarkable "meridional" or "magnetic nests" found from near the Bloomfield River, North Queensland, to Palmerston, Port Darwin. The Meridian white ants build long narrow structures, always running from east to west, and never vary from that direction (D. Le Soeuf, 1894).[2] Holtze states according to Froggatt (1897) that "these nests average from 10 to 12 feet in length in the form of a wall convex on one side and concave on the other, the sides respectively facing the rising and setting sun." They are about 8 feet in height, with the top straight, crowned with little turrets. Jack states (1897) that the reason that they are built at this angle is to secure the maximum of desiccation, thus enabling the insects to repair damages to the nests with safety during the wet season; that is, the material would thus dry as quickly as possible in tropical latitudes. Walker also described and figures these nests (Sharp, 1901).

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[1] On July 5, 1919, G. Hofer collected pale, yellowish brown winged adults flying to lamplight in Sabino Canyon, Santa Catalina Mountains, Arizona, which may be *R. tumiceps* or a new species. This is the first record that I have of species of *Reticulitermes* flying to light.

[2] An error. See Froggatt.

In the United States there are two known and four new species of *Amitermes*. The known species are *Amitermes tubiformans* Buckley and *A. wheeleri* Desneux; the new species—*A. arizonensis* Banks, *A. californicus* Banks, *Amitermes* (?) *perplexus* Banks, and *Amitermes* (?) *confusus* Banks. In case of the species *perplexus* and *confusus* there is some doubt as to whether or not they belong in the genus *Amitermes*. Later collecting and observations in the field will doubtless clear up the proper systematic position of these species.

AMITERMES (TERMES) TUBIFORMANS Buckley.

For taxonomy see pp. 55–56.

This interesting tube-forming termite was described in 1862 by Buckley from specimens of the soldier and worker from Lampasas, San Saba County, Texas. Buckley's descriptions of the soldier and worker, we will agree with Desneux (1905) are very vague.

A. tubiformans has a very wide distribution through Texas, occurring from Victoria south to Brownsville and west to El Paso. Morrill also found specimens near Mesa, Arizona. It occurs in Mexico, August Busck having collected specimens under cow dung at Camargo, Mexico, on September 2, 1917.

A. tubiformans Buckley of Texas and Arizona is a termite with a peculiar habit. It lives in the ground, being of subterranean habit, and is very common in and under dry cow chips, especially in prairie pastures. These termites cover low vegetation and grass with thin, earth-like mortar, usually after rains. The termites as a rule work at night. These termites are associated with *Amitermes wheeleri* Desneux, *Anoplotermes fumosus* Hagen and species of *Constrictotermes* under cow chips, on which they evidently feed.

Buckley (1862) states that this species often has clay tubes 4 to 6 inches high above the surface of the ground, interlacing and crossing each other at various angles and generally attached to grass or bushes. These tubes are very thin and from one-third to one-half inch in diameter; beneath these cylinders they also have cells in the ground. E. A. Schwarz (1895) writes that this species is extremely abundant in southwestern Texas, occurring in the spring beneath and within patches of cow dung, and after midsummer in the tubes around grass stalks and the stems of other plants.

In the prairie regions of both Texas and Arizona this termite lives in the ground, feeding on the roots of grass and other vegetation, and is sometimes found under stones, but more commonly under dry cow chips, where large colonies occur. This species sometimes destroys the vegetation over large areas of grazing land. One of its characteristic habits is to cover the stems and roots of vegetation with tubes of small diameter constructed of earth and excrement. Apparently it does not ever bore into wood. Schwarz found workers injuring grass at Beeville, Texas as early as November 10, 1895.

D. C. Parman made the following notes on termite injury to forage and food plants at Uvalde, Texas, in 1917.

> The common species of termite (*Amitermes tubiformans*) has been very abundant in this section this season and much damage has been done to range and forage plants and in some instances to gardens. The first injury noticed was in a garden, which had been heavily manured the year before, about August 10; the termites had been at work previous to this date, but after a heavy irrigation dirt tunnels were piled at the base of tomato, corn, and squash plants, and on the fruit of the squash and in some instances the squash fruit was broken into at the blossom end. The plants attacked were weakened and sickly and about 25 per cent died. On August 11, 1917, the first piling up of earth on plants was observed at Uvalde, although the garden has been irrigated the entire season. The weather has been dry and hot practically all summer. (There had been a 5-inch rain June 24, night, and on June 28 another light rain.) By the first of September at least 75 per cent of the entire plantings of the garden were injured, and some of all of the plants died, including 28 different vegetables. The older and tougher plants were preferred. The larger roots were eaten off, which caused a mass of small roots to start which could not support the plants.
>
> During the latter part of August several pastures were observed to have large areas in which practically all of the grass and weeds were killed, and in places practically all of the low dead vegetation had been covered with dirt.
>
> Sorghum fields were examined where as high as 50 per cent of all the plants had been attacked and small areas would be entirely killed. On October 20, a field (500 acres) of oats (volunteer) four miles north of Knippa, Texas, was examined in which about 60 per cent were dead; the dead spots were practically alive with the white ants and they were at some places found under apparently healthy plants. Other fields were found to be damaged more or less but the greatest damage was in fields of volunteer oats or where there was considerable stubble. Since this date fields have been examined near Uvalde and the termites were always present and doing some damage by eating the sprouted grain or young plants. On examination after a period of two cold days with a minimum temperature of 26 at the laboratory the termites are not found in nearby fields under plants showing evidence of the work; only shallow examinations (8 inches) were made (Oct. 31).
>
> The termite is always most abundant in trashy lands and in the sorghum lands. Control would probably be at least partially effected if all oat stubble fields were well turned and old sorghum stubble plowed during the fall and winter. It is apparently a bad practice to disk fields of oat stubble in an attempt to get a stand of volunteer oats, as they generally serve as a breeding ground for insects, especially the fall army worm.
>
> The damage by the termite has probably been more noticeable this season on account of the extreme drought, but it is quite probable that crops are damaged more or less every season, as the piling of earth on plants, generally dead, has been noticed.
>
> NOTE.—The determination was made by Mr. T. E. Snyder from specimens taken from a garden (in June (?), 1917); no specimens were taken from fields.

J. D. Mitchell observed this species constructing earthen-like tubes and in and under dry cow chips and in the ground, in the prairie near Victoria, Texas, on September 25, 1917. They were very numerous and were covering vegetation with "thin earth mortar" (pl. 33, figs. 1–5). They honeycomb dry cow chips and are numerous in the chips and in the ground under them.

The writer first observed this termite in the "prairie" 1 mile east of Victoria on April 19, 1917, where it was common under and in dry cow chips on the ground and in the ground. Manure is carried down into chambers below ground. Soldiers were not common in colonies. Some of the workers have the heads pigmented a yellowish-brown color, with antennae brown; other workers of the same size are without this pigmentation, merely different stages to maturity. Two young reproductive females of the second form and eggs were in the ground in a cell several inches deep in a colony. (Fig. 42, 3.) Nymphs of the first form with long wing pads were also in this same colony. The ground was very hard and the colony was dug out with an axe.

Anoplotermes fumosus Hagen was found for the first time by the writer associated with *A. tubiformans* under and in cow chips. It was noted after several days' search that there were no soldiers in the colonies of *Anoplotermes.*

In the vicinity of Brownsville, Texas, *A. tubiformans* was found to be common under cow chips; Lloma Alto Lake, Las Palmas, etc. (Apr. 22 to 25, 1917), also under dry dead cactus (prickly pear) *Opuntia* on the ground. Near Brownsville the smaller *Amitermes wheeleri* Desneux was first found by the writer, associated with *A. tubiformans* or *Anoplotermes,* in and under dry cow chips.

Near San Antonio colonies were also common in pasture land, April 26 to May 2. This species was also found by the writer at Cotulla, Texas, on May 1; the soil in this vicinity was very dry and deeply cracked by drought to the depth of 1 foot. Near Uvalde colonies were common and often very large, under cow chips; Chalk Bluff, Laguna on the Nueces River, and at Uvalde in pastures along the Leona River, and also on dry prairie land near Sansom.

At El Paso, on the foothills near the city, *A. tubiformans* was found on May 9 under cow chips and under the trunks of dead tree Yuccas lying on the ground.

In the vicinity of El Paso the vegetation on the bare rocky hillsides consists of cacti and *Agave,* creosote bush (*Covillea glutinosa*), etc.

At none of these localities in Texas at which the writer found this termite in April and May did he observe its tube-forming habits, which was doubtless due to the dry season. It was not until August (Uvalde) and September (Victoria) that these tubes were observed in 1917 by Messrs. Parman and Mitchell.

SWARMING.

A. tubiformans swarms during the daytime.

On July 5, 1916, D. C. Parman found this termite swarming at Uvalde, Texas. The swarm occurred from 2 to 4 p. m. in large numbers during a slow, steady rain. *Amitermes* (?) *perplexus* Banks swarmed at the same time. Parman's notes are as follows:

> For the last few days there had been a low barometer, with rising humidity and an occasional flurry of wind, temperature ranging from 98 and 73. To-day about 12:30 it began to rain, a moderate breeze following the rain, but quieted down soon after the rain began to fall. About 2 inches of rain fell until about 2 p. m.; after this time a slow steady rain followed until 4 p. m. During this time the air was full of the swarming termites. Several hundred could be seen in any direction. After the rain stopped no more termites could be seen, but the walks and the clean ground were literally covered with wings; there was scarcely a square yard in which no wings could be found in the vicinity of the laboratory. In many places from 300 to 500 could be found on a square foot. (It must be remembered that two species were swarming.) Many earth cells have been noticed in the more moist places in yards and irrigation places during the last month.
>
> The shedding of the wings was sometimes noticed while the insect was in the air. A wing would break off and fly away from the adult, which, in an unsteady manner, would finally fall to the ground. Some adults were observed to fall to the ground with wings intact, but would later fly again unless the wings were loosened in the attempt.
>
> Ants were observed to destroy large numbers of the termites after they lost their wings.

Near Uvalde, Texas, on May 3, 1917, the writer found colonies with nymphs of the first form with long wing pads, and on May 5, in a moist pasture near irrigation north of Uvalde, the writer found a large colony under a cow chip on grass soil with winged mature adults present ready to swarm. They occurred under the cow chip and in the soil. There were earthen tubes on the soil. The cow chip was under a small bush. There was a heavy rain on May 5 and 6.

The egg is white, slightly reniform, and approximately 0.55 to 0.60 mm. in length.

References to biological or economic literature.

1862. Buckley, S. B. Proc. Ent. Soc. Philadelphia, vol. 1, pp. 212–3 (*Termes tubiformans*).

1896. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 4, No. 1, pp. 39–40 (*Termes tubiformans* Buckley).

1901. Howard, L. O. The Insect Book (*Termes tubiformans* Buckley), p. 356.

1916. Snyder, T. E. Bull. U. S. Dept. Agric. No. 333, Feb. 16, pp. 12–3, pl. 3 (*Hamitermes tubiformans* Buckley).

1916*a*. Snyder, T. E. Farmers' Bull. 759, U. S. Dept. Agric., Oct. 9, pp. 10–11.

1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.

1919. Thompson, C. B. Biol. Bull., vol. 36, No. 6, pp. 379–398, June.

AMITERMES ARIZONENSIS Banks.

For taxonomy see pp. 56–59.

This termite, found in Arizona, apparently has similar habits to *A. tubiformans* of Texas, which it closely resembles. *A. arizonensis* has been found at Fort Grant (Graham County) (Hubbard); Oracle (Schwarz), (Wheeler) and Ray Junction (Barber) (Pinal County); in the Santa Catalina Mountains, Brush Corral Station (Chrisman), and Sabino Canyon (Snyder and Hofer); desert near Tucson (Snyder); and Nogales, Santa Cruz County (Snyder), in Calabasis and Aqua Fria Canyons, (Snyder).

In California the writer found workers of what is probably this species at Arrowhead Springs, in San Bernardino County, on June 3, 1917. This colony was under a dead flower stalk of *Agave* lying on the ground and under this in the ground. No soldiers could be found. The workers were too large to be *A. californicus* Banks, and earthen tubes had been constructed through the dry, hollow interior of the stalk.

Later specimens of workers and soldiers of *A. arizonensis* were found in the United States National Museum which had been collected at Palm Springs (Riverside County), California, by H. G. Hubbard as early as March, 1897. Hubbard found them in colonies under stones in canyons, and states in his field notes that they are the commonest termite at Palm Springs. The flora and fauna at Palm Springs (desert) are similar to Arizona.

H. S. Barber found a colony of this termite at Ray Junction, Arizona, on January 10, 1914. The workers were making earth-like tubes on the stems of vegetation and on the roots under stones.

M. Chrisman collected workers and soldiers of *Amitermes arizonensis*, on September 23, 1914, at Brush Corral Station (elevation 4,000 feet), Santa Catalina Mountains, Arizona, on a dead mesquite stump. The termites were under a dry mud coating at the base of a stump, fallen limbs, twigs, etc., always on the dry wood. This species does not excavate cells in the wood, but seems to eat off only the exterior. These termites were first noticed in early August. At that time the coating appeared fresh. The termites were very common under the coating, but no winged forms were present.

On October 3, at this same locality, termites were collected in dry cow manure. These termites were first observed in "cow chips" on August 6. On October 3 they were excavating in the ground beneath the chips. No young were present.

The writer collected colonies of this termite in the desert near Tucson, Arizona, on May 12, 1917. Workers, soldiers, and nymphs of the first form with wing pads not fully grown were under dry cow chips and in galleries in the ground under them.

Similar colonies were found in Sabino Canyon, in the Santa Catalina Mountains, on May 14, under dry cow chips. Near Nogales, on May 20, 1917, in Calabasis Canyon, 15 miles west of Nogales, workers and soldiers and nymphs of the first form were found in colonies under dry cow chips. Colonies were also found in pasture land at the mouth of Aqua Fria Canyon under dry mesquite brush.

George Hofer also found colonies of this termite in Sabino Canyon on January 9, and July 23, 1918, under cow chips.

Workers and soldiers were again found by George Hofer on July 26 in the roots of dead and broken off stems of *Encelia ferrinosa*, and in the roots of an injured but living bush of *Artemesia*, species, on July 30, in this same locality.

SWARMING.

Winged adults have been collected flying at Oracle, Arizona, on July 5 (Hubbard and Schwarz); on July 9, at Fort Grant, Arizona (Hubbard), and on July 5, 14, and 28 at Sabino Canyon, Santa Catalina Mountains, Arizona (at light, Hofer).

References to biological or economic literature.

1916. SNYDER, T. E. Bull. U. S. Dept. Agric. No. 333, p. 12-13, Feb. 16 (*Hamitermes tubiformans* Buckley).

1919. SNYDER, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97-104, May.

AMITERMES (TERMES) WHEELERI Desneux.

For taxonomy see pp. . 59-62

Desneux (1905) described this termite, in 1905, from specimens of soldiers and workers from Texas, sent to him by Prof. W. M. Wheeler. The type locality is Belton, Texas, April, 1902, W. M. Wheeler collector. It is widely distributed throughout southwestern Texas. The writer found this small species from San Antonio south to Brownsville and Cotulla and west to El Paso.

Unlike the two other species of *Amitermes* just discussed, namely, *tubiformans* Buckley and *arizonensis* Banks—while subterranean in habit, this termite is also a destructive wood borer. Like *Amitermes californicus* Banks, a similar small species of California, this termite is often found between the lower rosettes of leaves and in the dead flower stalks of species of *Agave* which the Mexicans call "Lechuguilla" —growing on the foothills near Laguna (Uvalde County) and El Paso.

A. wheeleri damages the foundations of buildings, windmill towers, poles, fences, etc., and any wood in contact with the ground. The wood is honeycombed.

This species is also found under and in dry cow chips associated with *A. tubiformans* and *Anoplotermes fumosus* Hagen. It was in such a habitat that the writer first found this termite at Brownsville, Texas, on April 23, 1917, under and in dry cow chips and in the ground near Fort Brown in a wooded pasture land, the trees being mesquite, huisach (*Acacia farnesiana*) and "catsclaw." The writer at once recognized it as something he had never seen before and, not knowing that Desneux's species "*Termes*" *wheeleri* was an *Amitermes*, thought that this small species (the soldier having short, curved, sickle-shaped mandibles) was the same that F. P. Keen had found in California (*A californicus*). The soldiers were rare in the colonies.

Near San Antonio, Texas, this species was again found on April 25, under cow chips, in wooded pasture land, 5 miles south of the city.

On May 1 at Cotulla, Texas, the writer again found this termite in the interior of fence posts badly riddled by wood-boring beetles, whose numerous exit holes were throughout the posts. The burrows of this termite in the wood were spotted with excrement.

At Uvalde, Texas, on May 3, this species was found in the wood (pine) of the foundations of a building; excrement spots were on the wood and the work was apparently similar to that of species of *Reticulitermes*.

At Laguna, Texas, on May 4, the writer found a colony of *wheeleri* in the dry, hard wood of a stump; the wood was solid and was honeycombed by longitudinal galleries. (Pl. 7.) The wood was spotted with excrement.

On May 5, at Chalk Bluff, another colony was found in the pine foundations of a building, the wood being honeycombed and spotted with excrement, as in case of *Reticulitermes*. Earthen tubes were constructed on the wood. Other colonies were found in logs on the ground. The surface of the wood on the ground is eaten off and covered with earthen tubes. The heartwood is often penetrated through cracks, as do species of *Reticulitermes* and *Prorhinotermes simplex* Hagen. These colonies were of large size. Wood lying on the ground, such as boards, have the surface eaten in broad shallow tunnels and the surface covered with soil.

At Chalk Bluff, colonies were found in "Lechuguilla" (*Agave*) in the foothills and also at El Paso, Texas. At the latter locality, a colony was found on May 9, in the lower rosette of dead leaves and in earthen tunnels through the flower stalk of *Agave*. The vegetation on these bare, rocky hillsides (Piedmont Heights, above the smelter) overlooking the Rio Grande into similar country near Juarez, Mexico, consists of cactus, *Agave*, creosote bush (*Covillea glutinosa*), etc. These plants furnish the only conditions where termites could obtain proper conditions of moisture, except under cow chips.

T. S. Wilson found this termite damaging corn kernels and young sprouting corn in fields near Brownsville, Texas, on April 23, 1917. The injury was apparently only local.

No winged adults of this species have been found as yet.

AMITERMES CALIFORNICUS Banks.

For taxonomy see pp. 62–63.

F. P. Keen found workers and soldiers of this termite on August 24, 1915, at Jacumba, California, feeding on the surface at the base of the rind of a dead flower stalk of *Yucca*, where protected by the leaf bases, which are closely appressed to the stalk. The insects worked between the rosette of leaves and the flower stem. Jacumba is in San Diego County, at about the crest of one of the coast ranges of mountains, near the International Boundary Line, at an elevation of 3,500 feet. The vegetation where this termite was found consists of cactus, *Yucca*, *Agave*, etc.

Probably this species occurs in similar floral regions or life zones in Lower California.

In Arizona George Hofer collected soldiers and workers in Sabino Canyon, Santa Catalina Mountains, on February 14, 1918, under cow chips.

This species is apparently similar in habit to *Amitermes wheeleri* Desneux of Texas. The soldier of this new species is distinct from that of *wheeleri*.

The writer found colonies of this termite at Arrowhead Springs, in San Bernardino County, California, on June 3, 1917. The foothills of the San Bernardino Mountains have vegetation similar to that found near the boundary line to Lower California—cactus (*Opuntia*), *Yucca* and *Agave*, etc.—being somewhat similar to that of the Arizona and California desert regions. There is also a dense growth of *Ceanothus* on the foothills. These colonies of *A. californicus* consisted of workers and soldiers only and the soldiers were rare; they were in between the lower rosettes of leaves and the dead flower stalks of a narrow-leaved Spanish bayonet or *Agave;* the saw teeth on the edges of the leaves are minute.

Workers and young reproductive nymphs with short wing pads of this termite were found under a low spreading plant of *Chamaesyce polycarpa* at the eastern end of Coyote "Wash", on the Colorado desert, in Imperial County, California, on March 29, 1919, by W. D. Pierce.

SWARMING.[1]

George Hofer collected winged adults of this termite by lamplight in Sabino Canyon, Santa Catalina Mountains, Arizona, on June 20, and on July 10, 11, 12, and 13, 1918. *Kalotermes minor* Hagen and *K. hubbardi* Banks also flew to the light on the same evenings. In 1919, Hofer collected adults flying on July 5, 14, and 28, at Sabino Canyon, with *A. arizonensis*.

A. californicus, therefore, is a nocturnal flying species.

References to biological or economic literature.

1916. Snyder, T. E. Bull. U. S. Dept. Agric. No. 333, p. 26, Feb. 16 (*Hamitermes*, species).

1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.

AMITERMES (?) PERPLEXUS Banks.

For taxonomy see pp. 63–65.

There is still some doubt as to which genus this species belongs; it is confined to Texas. As yet only winged adults have been collected and no soldiers or possibly nasuti have been found with these adults in the same colony.

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[1] In Sabino Canyon, Arizona, in 1919, *A. californicus* adults were collected flying from July 5 to August 28.

SWARMING

J. D. Mitchell collected a large number of winged adults of this termite at Victoria, Texas, on July 8, 1907. E. S. Tucker collected adults as far north as Clinton (Hunt County), Texas, in June.

D. C. Parman has collected this species at Uvalde, Texas. On July 5, 1916, he described a large swarm which occurred from 2 to 4 p. m. *A. tubiformans* Buckley swarmed at the same time and the flight is described in detail under that species. On June 25, 1917, Parman again collected *A.* (?) *perplexus* swarming at Uvalde. His field notes are:

> A heavy rain (5 inches) fell last night, the first since May 7. The clouds are light and light sprinkles of rain are occasionally falling at 9 a. m. At this time a few termites were observed flying; at 9.15 during a light sprinkle of rain a large swarm passed the insectary, lasting about five minutes. At 9.25 scarcely a specimen could be seen on wing; few specimens taken from foliage, ground, and Tabanid tent; in alcohol.
>
> June 29. No other flight has been observed to date. A light rain fell yesterday, June 28, p. m.
>
> Temperature during flight about 75° F. Maximum for June 24, 98° F.; minimum for June 25, 68° F. Flight was with the wind (SE. to NW.); light air to light breeze.

Other winged adults in the collection of the United States National Museum have labels that read: "San Diego, Tex., 31, 5," 1895, E. A. Schwarz; Brownwood, Texas, winged adults, July 16, 1891, L. F. Bickford; "Olivia, Tex., VII, 19, 1907; J. D. Mitchell, collector."

These records indicate a wide distribution in Texas, from Clinton in Hunt County, near the Oklahoma line, to San Diego in Duval County, not far from the Mexican border, and to Olivia in Calhoun County, on the Gulf of Mexico, west to Uvalde.

AMITERMES (?) CONFUSUS Banks.

For taxonomy see pp. 65–66.

This termite, like *A.* (?) *perplexus* Banks, is well named. It inhabits Arizona and Texas. Only winged adults have so far been found. There is also doubt as to this species' proper generic position.

SWARMING.

In Arizona, H. G. Hubbard collected flying adults at Fort Grant, "9/7"; Hubbard and Schwarz at Oracle, July 2; Biederman at Florence; F. H. Snow in the Santa Rita Mountains, in June, elevations 5,000 to 8,000 feet; at Higley, July 30, 1917 (Wheeler); Black Dike Prospect, Serritas (Lutz and Rehn), Serritas, July 25–29, 1917 (Lutz and Rehn). In Texas, Prof. W. M. Wheeler collected adults flying in June and July, Fort Davis, Jeff Davis County.

Nothing else is known of the habits of either *Amitermes* (?) *perplexus* or *confusus* Banks.

Genus ANOPLOTERMES Fritz Müller.

This genus is particularly interesting because there is no soldier caste. This is exactly the reverse condition of that in the genus *Kalotermes*, where there are no workers. In the genera *Termopsis* and *Neotermes* while there are apparently no true workers, there is a form[1] with no wing pads which is worker-like, and attends to the duties of workers. According to Sharp (1901), the species *Anoplotermes pacificus* Fritz Müller differs from other termites in possessing a proventriculus destitute of triturating ridges.

ANOPLOTERMES FUMOSUS Hagen.

For taxonomy, see pp. 66–69.

In the United States there is but one species in this genus, namely, *A. fumosus* Hagen, described from Vera Cruz, Mexico. This termite occurs in southwestern Texas and is especially common near the Mexican border, living in the ground and in and under cow chips. It is usually associated with other species of termites—usually species of *Amitermes*—but also with *Constrictotermes* and rarely *Reticulitermes*—under decaying logs sunken into the ground; probably in a symbiotic relationship. The workers of this species have the peculiar habit of crawling about in single file, closely following one another. These workers are of a dirty grey color and have a rather elongate, fusiform, or bag-shaped body. "Grey backs" would be a good descriptive name. (Fig. 53.)

The remarkable point is the absence of the soldier caste. The writer spent many days' search looking for the soldier caste, and, after fruitless search, thought of the South American genus *Anoplotermes*. This was confirmed when workers of *A. pacificus* Fritz Müller were seen at the Museum of Comparative Zoology, in Hagen's collection. The jaw of the sexual adult is very long, and this, with the absence of the frontal gland, enables it to be readily distinguished.

Hagen described this termite from Vera Cruz, Mexico. P. Cardin collected workers in the earth at Santiago de las Vegas, Cuba, on August 23, 1918. These may belong to another species of *Anoplotermes* (*schwarzi* Banks) whose habitat is Cuba.

After recognizing the genus from the worker caste, Mr. Banks found that J. D. Mitchell had collected winged adults of *A. fumosus* Hagen at Harlingen, Texas, as early as August 1, 1906. Mr. Mitchell collected a large number of adults (now in the United States National Museum collection) so that the species must have been swarming. Harlingen is not far from the Mexican border. This species has been found in Mexico at Matamoras (across from Brownsville, Texas); the adults were swarming and are now in the Hagen collection.

The writer found the first workers of this termite at Victoria, Texas, on April 19, 1917, and was immediately struck by their peculiar habit, shape, and color. At first he thought them to be a species of "*Eutermes*," but was unable to find any nasuti. Colonies were in and under dry cow chips in prairie land, and always associated with species of *Amitermes;* at Victoria, *A. tubiformans* Buckley.

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[1] Reproductive.

In the vicinity of Brownsville, Texas, colonies were found from April 23 to 25, usually with species of *Amitermes* under and in dry cow chips, sometimes deep in the ground, in pasture land along the Rio Grande, below Fort Brown. The ground was often very hard and dry. Two other termites, *A. tubiformans* Buckley and *wheeleri* Desneux, commonly occurred with this species.

On May 24 the writer found a colony of *Anoplotermes fumosus* under a moist uprooted stump deeply sunken in the ground along the wooded river bank (Rio Grande). A colony of *Reticulitermes claripennis* Banks inhabited this log and had constructed earthen galleries and chambers (of clay soil along the bottom of the log and ground). *A. fumosus* was found in these chambers; workers, nymphs, white and with short wing pads (probably young nymphs of the first form), eggs, and young.

The recently hatched young appeared to have a peculiar, faint, light grey (almost violet) color.

On April 27 similar colonies were found at San Antonio under cow chips in pasture land; and on May 7 the writer found colonies in pasture land, along the Leona River, near Uvalde, Texas.

SWARMING.

This species swarms in August.

The egg is white, slightly reniform, and approximately 0.56 to 0.65 mm. in length.

References to biological or economic literature.

1860. Hagen, H. A. Linnaea Entom., vol. 14 (Nachtrag), pp. 123–4, (*Termes fumosus*).
1896. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 4, No. 1, p. 41. (*Termes* [*Eutermes*] *fumosus* Hagen.)
1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.
1919. Thompson, C. B. Biol. Bull, vol. 36, No. 6, p. 379–398, June.

Genus NASUTITERMES Banks.

Mr. Banks has accepted Dudley's name, proposed in 1890—namely *Nasutitermes*—which Dudley used for a *Eutermes* with a nasute head several months before he used the term "milesnasutitermes." However, Dudley did not give any species to his name. The head of the nasutus is not constricted, as in the species of *Constrictotermes* Holmgren. This form, the "nasutus," takes the place of the mandibulate soldier. This caste will be discussed later under the genus *Constrictotermes*.

NASUTITERMES COSTARICENSIS Holmgren.

(For taxonomy, see pp. 69–71.)

Only one species of *Nasutitermes* has been found in the United States—namely, *costaricensis* Holmgren. This species occurs in Cuba and Porto Rico in the West Indies. Specimens of sexual adults deälated (adults without wings) and nasuti are in the collection of N. Banks in a vial with label "Texas."

Genus CONSTRICTOTERMES Holmgren.

The species of the genus *Constrictotermes* are of special interest because of the presence of "nasuti" instead of mandibulate soldiers. This caste is peculiar in that there is an elongation of the head into a long, pointed beak. Dr. L. O. Howard (1901), in referring to the "nasutus" caste, with this nose-like process, states that this term "must at once remind the admirers of Sienkiewicz of the Polish warrior Kharlamp." Through this beak is exuded a fluid which is used in defense and also in making or repairing the earth-like tubes through which the insects travel.

As will be noted, the species of *Constrictotermes* swarm at night, the flight commencing at dusk. The swarm usually takes place just after a rain, since the insects could not otherwise become established in the hard, dry ground after the swarm. The species of *Constrictotermes* live in the ground and they occur with species of *Amitermes* and *Anoplotermes* under cow chips.

CONSTRICTOTERMES TENUIROSTRIS Desneux.

For taxonomy see pp. 71–73.

This termite was described by Desneux (1904*a*) from specimens of the nasuti and workers from Etat de Jalisco, Mexico, collected by L. Diguet, 1900, with the note "Fait des nids sur les arbres élevés"; also Orizaba, coll. Bilimék. Desneux later (1905) described the winged imago. The winged adults are from Fort Davis, Jeff Davis County, Texas, W. M. Wheeler, collector. The size of the winged adults, in relation to the nasuti and workers, is very great; they have long wings. The species occurs in both Arizona and Texas. It does not construct nests on trees in the United States, as is its habit in Mexico, according to Diguet.

Species in the genus *Constrictotermes* Holmgren are subterranean in habit; they do not construct large spherical tree nests, as do species of *Nasutitermes* Banks. *C. tenuirostris* does not build nests in trees, as recorded to be its habit in Mexico (Desneux, 1904*a*). It is more likely that this Mexican species is some other species near *N. morio* Latreille.

SWARMING.

C. tenuirostris Desneux swarms at night. R. E. Kunze collected winged adults flying as early as June 25, 1899, in the Huachuca Mountains, Arizona. E. A. Schwarz also collected this species in the Santa Catalina Mountains, Arizona. F. H. Snow collected adults swarming in July in the Santa Rita Mountains, Arizona, at an elevation of 5,000 to 8,000 feet. Flying adults were also collected by C. R. Biederman in July and August at Palmerlee, Arizona, also at Garcia. Oslar collected adults swarming at Nogales, Arizona, on July 1, 1903. M. Chrisman noted a swarm at Brush Corral Station (elevation 3,520 feet) in the Santa Catalina Mountains, Arizona, in July, 1915. The adults commenced flying at dusk on July 18, coming readily to light. The ground was damp, since the first rain on July 12. On July 20 adults were collected at 10 p. m., there being a fine drizzle at the time. Prof. W. M. Wheeler collected adults in Post Canyon in the Pinaleno Mountains, Arizona (elevation 5,000 to 6,000 feet), on July 17 and 18, 1917. George Hofer collected adults at light in Sabino Canyon, Santa Catalina Mountains, Arizona, on July 7, 1919.

References to biological or economic literature.

1905. Desneux, J. Ann. Soc. Ent. Belg., vol. 49, pp. 341–342. (*Eutermes tenuirostris* Desneux.)

1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.

CONSTRICTOTERMES (TERMES) CINEREUS Buckley.

For taxonomy see pp. 73–75.

Buckley described this species in 1862 from specimens of nasuti and workers. The type locality is San Saba County, Texas. Wheeler found this species common in the vicinity of Austin, Texas, according to Desneux (1905), who redescribed the soldier and worker castes. Desneux (1905) states that this species is a sort of a reduction of *tenuirostris*, which is very nearly related but without doubt distinct. The winged adults were unknown. Desneux states that Buckley's descriptions are, for the most part, fantastical.

Buckley (1862) writes:

> It was about sunset on the 22d of October, 1860, when I first saw this species, in San Saba County, Texas, in a field where both workers and nasuti were carrying home seeds of grasses and weeds. They marched in dense columns along pathways leading to a hole near the base of a stump, into which they entered. Others were marching outward in search of provender. The nasuti are about one-fourth to one-fifth of the entire community. They dwell in the ground where they have rooms, seldom more than one to two inches long, connected by tunnels. They march with heads erect and thrown backwards over the thorax, carrying their loads with their mandibles.
>
> Subsequently, while engaged in the geological survey of that and the adjoining counties, I met them frequently. After rains, which are of rare occurrence in that climate, they make semicylindrical tubes which lie on the surface of the ground to the length of from 3 to 6 inches. These arched ways sometimes intersect each other, being connected with chambers below. They rarely work by day above the surface

> and never in the bright sunshine. In June, 1861, in Llano County, I saw them carrying home dry segments of post-oak leaves of the preceding year's growth. Here again the nasuti worked in common with the rest of the tribe. They must have preferred these dry leaves, because green leaves and grass were abundant on every side. They are all quite active, moving faster than any species of termites which I have seen.

C. cinereus occurs from central Texas to Beeville, not far from the Mexican border, west to New Braunfels (Comal County) and Uvalde and Devils River (Valverde County). It swarms at night.

Schaupp collected this termite as early as 1889 (December ?) at Tiger Mills in Burnett County, Texas.

The late F. M. Webster on March 23, 1891, found a colony of this termite in the nest of a beaver at Devils River, west of Del Rio, on the Mexican border on the Rio Grande, Texas. A young true or first form queen was present. (Fig. 58, 1.) This was on the famous expedition after beaver parasites along the Pedernales River (Blanco County). E. A. Schwarz found colonies at Beeville and San Diego in 1895. On November 8 a colony was found under cow dung at Beeville; on May 31 workers and nasuti were found on the underside of fungus at San Diego; and on December 3 another colony under a stone at San Diego. R. A. Cushman found this termite at Lampasas on April 14, 1909. His notes are:

> Under a flat stone found a colony of peculiar termites, including the queen, workers, soldiers, nymphs, and eggs. The workers are Collembola-like in form, having large, rounded heads and stout abdomens. The soldiers are much smaller than the workers; have black or dark brown shining heads prolonged into a pointed beak. While the workers are not more than three-sixteenths inch long, the queen, though not distended, is at least one-half inch long and stout, with the thorax nearly as wide as the abdomen; in the worker the thorax is very narrow. (The queen was of the first form; a young queen.)
>
> When I turned the stone over the workers began running around very actively and carrying the eggs and nymphs into the subterranean burrows. Under the same stone was a colony of ants of the genus *Pheidole* and another colony of termites of a different species. None of the latter were collected.

This queen was 11 mm. in length, with abdomen slightly distended.

Near Uvalde, Texas, the writer found colonies of *C. cinereus* early in May, 1917. On May 4, at Laguna, Texas, 20 miles north of Uvalde, workers and nasuti were again found under cow chips associated with *Amitermes tubiformans* Buckley, near an irrigation ditch. Earthen galleries were in the dung and in the soil to the depth of several inches. The nasuti are very peculiar looking and of great interest to one seeing them for the first time. They are smaller than the workers. On May 5, north of Uvalde, in a moist pasture (green grass) near irrigation, other colonies were found. The cow chips were moist and fairly fresh. The termites (workers and nasuti) were in the soil and in earthern galleries on the bottoms of the cow chips. These tubes lead from the ground to the chips.

The workers have large brown-colored heads and the nasuti small black heads and long legs and antennae. These colonies were not large and the nasuti were rare. Probably the real nest is deep underground.

This termite, as well as other species in the genus *Constrictotermes,* is injurious to living vegetation. On April 3, 1916, D. C. Parman collected specimens of workers and nasuti of *C. cinereus* at Uvalde, Texas, that were destroying living plants by sucking the juices. They worked only at night, disappearing very suddenly when approached with a light. The plants within the next day when the sun strikes them. They travel in a stream about the size of a finger and always travel in large numbers.

SWARMING.

D. C. Parman found this termite swarming at night on September 21, 1917, at Uvalde, Texas. His notes read:

> On the morning of September 21 many wings and an occasional mutilated large termite were observed about the laboratory. On this evening 8 p. m., two of these termites are at the light at my window. (Specimens collected.) The weather has been cool and raining for the last three or four days, and a slow rain has fallen almost continually. No termites have been observed to fly in daytime. (Temperature range, maximum 79, minimum 66.)

The egg is white, slightly reniform, and less than three-fourths millimeter in length.

References to biological or economic literature.

1862. Buckley, S. B. Proc. Ent. Soc. Philadelphia, vol. 1, pp. 212–213 (*Termes cinereus*).

1896. Schwarz, E. A. Proc. Ent. Soc. Wash., vol. 4, No. 1, p. 40 (*Termes nigriceps* Haldeman).

1905. Desneux, J. Ann. Soc. Ent. Belg., vol. 49, pp. 342–3 (*Eutermes cinereus* Buckley).

1919. Snyder, T. E. Proc. Ent. Soc. Wash., vol. 21, No. 5, pp. 97–104, May.

"EUTERMES" (TERMES) NIGRICEPS Haldeman.

Haldeman (1853) described this termite from western Mexico, in 1853. The type of this species is lost and the description would fit at least two other species, and probably other allied species occur in Mexico, so Mr. Banks has dropped this name for the present.

Schwarz (1896) states that he does not hesitate in identifying Haldeman's *Termes nigriceps* with a species of *Eutermes* tolerably abundant throughout southwestern Texas. He says:

> Buckley's description of "*Eutermes cinereus*" agrees with my specimens, but his account of the mode of occurrence and habits greatly differs from my observations. Both Haldeman and Buckley describe only the workers and nasuti. Haldeman was informed by his correspondent that "this small species constructs nests, apparently of cow's dung, which are attached to the trunks of trees." Buckley observed his species in San Saba and adjoining counties of Texas.

[(Schwarz's San Diego, Texas, specimens were *Constrictotermes cinereus* Buckley and *Amitermes* (?) *perplexus* Banks, winged adults of the latter being collected on May 31 and thought to be "*Termes fumosus* Hag.").]

I found this species [(*Constrictotermes cinereus* Buckley)] throughout spring and fall in smaller or larger colonies, usually within tolerably dry cow's dung, in which it constructs long and winding galleries. Other colonies were seen under fence boards lying on the ground, and one under a large *Polyporus* lying on the ground. The species is much more active than any other termite known to me, and closely resembles in its movements one of the wingless Psocids. The colonies are composed of workers and nasuti, the former being much more numerous than the latter. In no instance has a single larva or sexed individual ever been seen in such situation. It must be inferred, therefore, that the true nest is deep in the ground.

On May 31 a flight of termites [*Amitermes* (?) *perplexus* Banks] "took place on the public square of the town of San Diego during a rainstorm. I failed to find the exact spot from which the swarms issued, but the specimens proved to belong to *Eutermes*. Since no other species of this genus was ever seen by me in southwestern Texas, I infer that these winged specimens belong to *Eutermes nigriceps*. They agree well with Hagen's description of *Termes* (*Eutermes*) *fumosus* from Vera Cruz, Mexico (Linn. Ent. 14, p. 123), of which Dr. Hagen himself thinks that it may be the winged form of Haldeman's species."

References to taxonomic, biological, or economic literature.

1853. Haldeman, S. S. Proc. Acad. Nat. Sci., Philadelphia, vol. 6, p. 365 (*Termes nigriceps*).

1858. Hagen, H. A. Linnaea Entom., vol. 12, p. 230 (*Termes* [*Eutermes*] *nigriceps* Haldeman).

1901. Howard, L. O. The Insect Book, p. 356 (*Eutermes nigriceps* Haldeman).

1904. Desneux, J. (Wytsman, P., "Genera Insectorum," fasc. 25), Isoptera, fam. *Termitidae*, p. 46 (*Eutermes nigriceps* Haldeman).

LEUCOTERMES TENUIS Hagen.

For taxonomy see p. 76.

This species, whose habitat is Santo Domingo (Port aux Princes) and Brazil (according to Hagen), has also been found in the Bahamas (Fish Hawk Key, Andros Island) by Desneux. He collected winged adults on May 19, 1904. According to Sharp (1901) this termite was introduced to the Island of St. Helena and was so destructive that Jamestown, the capital, was practically destroyed and new buildings had to be erected.

SWARMING.

This termite swarms during the first part of May in Cuba and the Bahamas. Winged adults were collected on Fish Hawk Key, Andros Island, Bahamas, May 19. It occurs in various places in Cuba and southward to South America. E. A. Schwarz collected winged adults of this termite at Cayamas, Cuba, "6/5, 18/5, and 11/6." Specimens of workers and soldiers of *L. tenuis* from Coxipo, Cuyabà, Brazil, are in the collection of the United States National Museum. This species occurs in Panama, Obispo (Banks, 1918).

According to Silvestri (1903) *Leucotermes tenuis* has two types of soldiers—"miles major" and "miles parvus." Mr. Banks and the writer have been unable to find two types of soldiers in this species, but we only have a limited amount of material.

Silvestri records finding a queen, which is evidently of the second form.

Due to the fact that this termite occurs in the Bahamas, Mr. Banks believes that it probably will be found on the Florida Keys. At any rate this destructive termite might be very easily introduced to the mainland of Florida or elsewhere in the United States.

References to biological or economic literature.

1875. Meliss, J. C. St. Helena, pp. 171–6, (*Eutermes tenuis* Hagen).
1898. Haviland, G. D. Journ. Linn. Soc. (Lond.) Zool., vol. 26, pp. 399–400.
1901. Sharp, D. Camb. Nat. Hist., vol. 5, Insects, pt. 1, p. 389 (*Termes tenuis* Hagen).
1904. Desneux, J. (Wytsman, P., Genera Insectorum, fasc. 25) Isoptera, Family *Termitidae*, p. 33 (*Termes tenuis* Hagen).
1918. Banks, N. Bull. Amer. Mus. Nat. Hist., vol. 38, art. 17, p. 663, Nov. 29.
1919. Banks, N. Bull. Mus. Comp. Zool., vol. 62, No. 10, p. 481.

LITERATURE CITED OR READ.

1758. Linnaeus, C. System. Nat., ed. 10 (1758); ed. 13, (1788–93), Gmelin, vol. 1, pt. 5, p. 2911 (Genus *Termes* described).

1792. Rossi, P. Mant. Ins. Etr., vol. 1, p. 107 (1792); vol. 2, pl. 5, *f. k.* (*Termes lucifugus* described).

1801. Latreille, P. A. Hist. Nat. Crust. Ins., vol. 3, p. 293; vol. 13, p. 51, 1804. (Family Termitinae established.)

1811. Latreille, in Humboldt, Obs. Zool., vol. 2, p. 111 (*Termès marginipenne* described, Mex., Calif.).

1829–1844. Guerin-Meneville, F. E. Iconog. du régne animal de G. Cuvièr, etc. Paris, 1829–1844. 7 vols.

1833. Latreille, Insectes de L'Amérique Equinoxiale, in Humboldt, Recueil d' Observations de Zoologie, Zoologie, vol. 2, Paris, p. 111. (CXLII. Termès Ailes-Bordées. *Termès marginipenne*, pl. 39, fig. 8).

1837. Kollar, V. Naturgeschichte der Schädlichen Insekten, Verhandl. Landwirthsch. Gesellshaft in Wien, vol. 5, new ser., 1837, p. 411 (*Termes flavipes* described, North America).

1839. Burmeister, H. Handb. Ent., vol. 2.

1840. Blanchard, E. Historie Nat. des Insectes. Paris, 1840–41.

1840. Westwood, J. O. Introduction to the modern classification of insects, vol. 2, p. 14. London.

1842. Rambur, J. P. Histoire naturelle des insectes Neuroptères. Paris.

1843. Bobe Moreau. Mémorie sur les Termites observés à Rochefort, etc.

1844. Haldeman, S. S. Proc. Acad. Nat. Sci. Phila., April, vol. 2, p. 55 (*Termes frontale* described).

1849. Heer, O. Insektenfauna der Tertiärsgebilde von Oeningen und von Radobojin Croatien, vol. 2, p. 23, Zurich (Genus *Termopsis* described).

1849. Joly, N. Recherches pour servir à l' hist. nat. et à l'anat. des termites. Mém. Acad. Sci. Toulouse, ser. 3, vol. 5, pp. 1–31, 3 pls.

1849. Savage, T. S. Observations on the species of Termitidae of West Africa described by Smeathman as *Termes bellicosus* and by Linnaeus as *T. fatale.* Proc. Acad. Nat. Sci. Phila., vol. 4, no. 11, Sept., pp. 211 to 221. (p. 216: "Tribes about 50 miles to windward of Cape Palmas use them (termites) as food; to catch them bowls of water are set on the ground, into which they fall as the wings drop off. They are then roasted as shrimps and the large beetles (goliathi) are said to be equally sweet".)

1852 to 1858. Walker, F. Catalogue of the specimens of Neuropterous insects in the collection of the British Museum, Part 3, pp. 501–532. Termitides. London, 1853. (Descriptions of North American termites.)

1853. Boffinet, XIII, Notice sur les Termites de la Charente-Infériure, Actes Soc. Linn. Bordeaux, ser. 2, vol. 9, pp. 145–157.

1853. Haldeman, S. S. Proc. Acad. Nat. Sci., Phila., vol. 6, p. 365, June. (*Termes nigriceps* from "Mexique" described.)

1853. Hagen, H. Ber. Akad. Wiss. Berl., p. 480 (Genus *Kalotermes* described).

1853. Quatrefages, de. B. Notes on the Termites of Rochelle, Ann. Sci. Nat., sér. 3, Zool., vol. 20, pp. 16–21.

1855–1860. Hagen, H. Monographie der Termiten. Linnaea Entomologica, vol. 10, 1855, pp. 1–144, 270–325; vol. 12, 1858, pp. 1–342, pl. 3; vol. 14, 1860 (Nachtrag), pp. 73–128.

1856. Lespès, C. Recherches sur l' organisation et les moeurs du termite lucifuge. Ann. Sci. Nat. Zool., sér. 4, vol 5, pp. 227–282, pls. 5–7.

1858. Fitch, A. Fourth Report on the Noxious and Other Insects of the State of New York, 1858, p. 8 (*Termes frontalis* association with the black and red ant *Formica rufa)* Trans. N. Y. State Agr. Soc., vol. 17, 1857, p. 694.

1858*a*. Hagen, H. A. Catalogue of Neuropterous Insects, British Museum. Pt. 1, Termitina. London.

1860. Scudder, S. H. Remarks upon the American white ant. Proc. Boston Soc. Nat. Hist., vol. 7, pp. 287–288.

1862. Buckley, S. B. Description of two new species of termites from Texas. Proc. Ent. Soc., Phila., vol. 1, pp. 212–213 ("*Termes*" *tubiformans* and "*Eutermes*" *cinereus* from Texas described).

1863. Packard, A. S. On synthetic types in insects. Boston Jour. Nat. Hist., vol. 7, no. 4, p. 590–603, fig. 4, June.

1865. Basch, S. Untersuchungen uber das Skelett und die Muskeln des Kopfes von Termes flavipes (Kollar). Journ wiss. Zool., vol. 15, pp. 56–75.

1873. Müller, Fritz. Beitrage zur Kenntniss der Termiten III. Jenaische Ztschr., vol. 7, Heft 4, pp. 451–463, figs. 3, Nov. 18.

1874. Hagen, H. A. Report on the Pseudo-Neuroptera and Neuroptera collected by Lieut. W. L. Carpenter in 1873 in Colorado, Ann. Rpt. U. S. Geol. Survey Ter. for 1873, by F. V. Hayden, p. 571–606.

1875. Melliss, J. C. St. Helena, pp. 171–176, 1875 (Before 1840 white ants were unknown on this island; captured slaver condemned and dismantled at Jamestown, in the timbers of which there was a South American species: *Eutermes tenuis* Hagen, common in Brazil. £60,000 worth of property destroyed on the island).

1875. Müller, Fritz. Beitrage zur Kenntniss der Termiten. Jenaische Ztschr., vol. 9 (n. s, vol. 2), pp. 241–264, pls. 10–13, Mai 8.

1876. Hagen, H. A. The probable danger from white ants. Amer. Naturalist, vol. 10, No. 7, pp. 401–410, July. (Predicts that white ants in the United States will retreat step by step with advancing civilization, but will prove to be injurious and that they should be guarded against; on p. 408 he tells an amusing incident of how the known capability for destructiveness by "white ants" was used by rogues to cover thievery; a very large property stored by the Government in Isle de France was reported as destroyed; the ministers sent to the officers a box containing files, with the strict order to file off the teeth of each ant or to resign the place.)

1876. Perris, E. Nouvelles promenades entomologiques, Termes lucifugus, Ann. Soc. Ent. France, ser. 5, vol. 6, pp. 201–202, 1876.

1877. Grant, R. D. (Ravages of Termes flavipes.) Trans. Acad. Sci., St. Louis, vol. 3, Journ. of Proc., p. cclxix, Nov. 19.

1877. Hubbard, H. G. Notes on the tree nests of Termites in Jamaica. Proc. Boston Soc. Nat. Hist., vol. 19, Dec. 26, pp. 267–274 ("*Eutermes*").

1877. Leidy, J. On intestinal parasites of Termes flavipes. Proc. Acad. Nat. Sci. Phila., vol. 29, for 1877, pp. 146–149, June 26 (Protozoan parasites).

1877. Osten-Sacken, C. R. Extract from a letter by Baron R. Osten-Sacken, on the specimens of Termes found by him in California. Proc. Boston Soc. Nat. Hist., vol. 19, pp. 72–73, for Jan. 3, 1877, June.

1877. Riley, C. V. Ravages of Termes flavipes. Trans. Acad. Sci., St. Louis, Dec., 1877, vol. 3, p. 269.

1878. Hagen, H. A. Note. Proc. Soc. Nat. Hist., Boston, vol. 20, p. 118, Nov. 27. (Large swarm of *flavipes* in Massachusetts and birds gorging on the insects.)

1879. Girard, M. Traite elementaire d'entomologie, vol. 2, pp. 261–294. (P. 270, states of *Termopsis:* "Le type est le *T. angusticollis* Hag.").

1881. Leidy, J. The parasites of the termites. Journ. Acad. Nat. Sci., Phila., ser. 2, vol. 8, p. 425–447, pls. 51–52, February.

1883. Packard, A. S. Third Report, U. S. Entomological Com. Wash., Termitidae; pp. 326 to 329, pl. 39, figs. 1–5; pl. 40, figs. 3, 4, 8; pls. 41; 42; 43, figs. 1–9, *Termopsis augusticollis. Termes flavipes.*

1884. Scudder, S. H. The fossil white ants of Colorado. Proc. Amer. Acad. Arts and Sci., vol. 19 (n. s. vol. 11), pp. 133–145.

1885. Hagen, H. A. White ants destroying living trees and changing foliage in Cambridge, Mass. Canad. Ent., vol. 17, No. 7, pp. 134–136, July.

1885. Hubbard, H. G. Insects affecting the orange, Washington, 1885, chap. 9, pp. 121–125, White Ants or "wood-lice."

1886. Packard, A. S. A new arrangement of the orders of insects. Amer. Nat., vol. 20, No. 9, p. 808, Sept.

1887–89. Dudley, P. H. Observations on the Termites or White Ants of the Isthmus of Panama. Trans. N. Y. Acad. Sci., vol. 8, pp. 85–114, 1888–89.

1887. Scudder, S. H. Further injury to living plants by white ants. Canad. Ent., vol. 19, no. 11, pp. 217–218, Nov.

1888. Maynard, C. J. Notes on the white ant found in the Bahamas. Psyche, vol. 5, pp. 111–113, (October). (Describes striking, hive-shaped tree nests in vicinity of Nassau, covered soil galleries lead down to the ground; also occur at Andros; these insects are very destructive to buildings, especially to the small houses of the negroes; work very rapidly (*Eutermes*, species).).

1889. Drummond, H. Tropical Africa. London (Chapter 6, "The White Ant: A Theory"). On the Termite as the Tropical-Analogue of the Earth-Worm.

1889. Dudley, P. H. (and Beaumont, J.). The Termites or so-called "White Ants" of the Isthmus of Panama. Journ. N. Y. Microscopical Soc., vol. 5, no. 2, April, pp. 56–70.

1890. Dudley, P. H. Observations on the Termites or White Ants of the Isthmus of Panama, Cont'd. Trans. N. Y. Acad. Sci., vol. 9, pp. 157–180. (On p. 158 the genus *Nasutitermes* was established; notes are given on how to distinguish the genera of termites by the nests and galleries (or burrows in wood); reference is made to damage by species of *Nasutitermes* and *Calotermes marginipennis.*)

1890. Dudley, P. H. (and Beaumont, J.). The Termites or so-called "White Ants" of the Isthmus of Panama. Journ. N. Y. Micros. Soc., vol. 6, no. 4, October, pp. 102–118.

1891. Scudder, S. H. More damage by white ants in New England. Psyche, vol. 6, no. 177, pp. 15–16, Jan.

1893. Grassi, B., and Sandias, A. Costituzione e sviluppo della società dei termitidi, etc. Dagli Atti dell' Accad. Gioenia di sci. nat. in Catania, vols. 6 and 7, ser. 4, Catania, 1893–4 (pp. 1–150 of author's separate).

1893. Joutel, L. H. Some notes on the ravages of the white ant (*Termes flavipes*). Journ. N. Y. Ent. Soc., vol. 1, No. 2, pp. 89–90, June.

1893. Riley, C. V., and Howard, L. O. Termites swarming in houses. U. S. Dept. Agr., Div. Ent., Insect Life, vol. 6, No. 1, p. 35, Nov.

1893. Stokes, Alfred C. The sense-organs on the legs of our white ants, Termes flavipes Kol. Science, vol. 22, No. 563, pp. 273-276, illus., Nov. 17.

1893. Townsend, C. H. T. Notes on Termopsis angusticollis Hagen. Zoe, vol. 4, No. 2, July 22, 1893.

1894. Le Soeuf, D. A visit to the Bloomfield River. Victorian Naturalist, vol. 11, p. 25 (Describes the nests of the meridional termite).

1894. Pérez, J. Sur la formation de colonies nouvelles chez le termite lucifuge (*Termes lucifugus*). Compt. Rend. Acad. Sci. (Paris), vol. 119, No. 19, pp. 804–806, Nov. 5.

1894. Riley, C. V. Social insects from psychical and evolutional points of view. Proc. Biol. Soc. Wash., vol. 9, pp. 1–74, figs. 12, Apr.

1895. Forbes, S. A. The white ants in Illinois (Termes flavipes Kol.), 19th Rept. State Entomologist of Ill. for 1893 and 1894.

1895. Froggatt, W. W. Australian Termitidae. Pt. 1, Proc. Linn. Soc. New So. Wales, vol. 10, ser. 2, July 31, 1895, p. 420. (Seoane (1879, Ent. Soc. Belg.) gives an account of a Spanish man-of-war which was completely destroyed by *Termes dives* while lying in the Port of Ferrol).

1896. Schwarz, E. A. Termitidae observed in southwestern Texas in 1895. Proc. Ent. Soc. Wash., vol. 4, no. 1. (Notes on *Termes flavipes* Kollar; *T. lucifugus* Rossi, *T. tubiformans* Buckley; *Eutermes nigriceps* Haldeman; *Termes* (*Eutermes*) *fumosus* Hagen; and *Calotermes marginipennis* Latreille.)

1897. Froggatt, W. W. Australian Termitidae, pt. 3, Linn. Soc. N. S. Wales, pt. 4, Nov. 24.

1897. Jack, R. L. Notes on the Meridional Ant Hill of the Cape York Peninsula. Proc. Royal Soc. Queensland, vol. 12, p. 99.

1897. King, G. B. Termes flavipes Kollar and its association with ants. Ent. News, vol. 8, no. 8, Oct., pp. 193–6.

1897. Porter, J. F. Trichonympha and other parasites of Termes flavipes. Bull. Mus. Comp. Zool., vol. 31, no. 3, pp. 45–68, pls. 6. Oct.

1897. Wasmann, E. Termiten von Madagaskar und Ostafrika. Abhandl. d. Senkenbergschen Naturf. Gesellsch., vol. 21, Heft 1, pp. 137–182. (Division of genus *Termes* (and *Eutermes*) based on soldier caste.)

1898. Haviland, G. D. Observations on termites, with descriptions of new species. (Read June 3d, 1897.) Journ. Linn. Soc. (London), Zool., vol. 26, pp. 358–442, pls. 22–25.

1898. Merriam, C. H. Life zones and crop zones of the United States. Bull. No. 10, Biological Survey, U. S. Dept. Agric., 79 pp. (Colored map of life zones of United States.)

1898. Osborn, H. On the occurrence of the white ant (Termes flavipes) in Iowa. Proc. Iowa Acad. Sci., vol. 5, for 1897, p. 231. (=*R. tibialis* Banks.)

1901. Banks, N. Thysanura and Termitidae. Papers from the Hopkins Stanford Galapagos Expedition 1898–99, Proc. Wash. Acad. Sci., vol. 3, Nov. 29, pp. 541–6.

1901. Howard, L. O. The Insect Book. New York, pp. 353–360. (Short account of habits of native species.)

1901. Schwarz, E. A. Note on first true termite queen in North America. Proc. Ent. Soc. Wash., vol. 4, no. 4, p. 347, Jan. meeting (1889), 1901. (=*R. humilis* Banks.)

1901. Sharp, D. Cambridge Nat. Hist., vol. 5, Insects, pt. 1, chap. 16, pp. 356–390, London.

1901. Silvestri, F. Boll. Mus. Torino, vol. 16, No. 389, p. 3 (Genus *Leucotermes* described), p. 4 (Genus *Amitermes* described), 1901; also in Redia, vol. 1, p. 37 (1903).

1902. Haviland, G. D. Observations on Termites or White Ants. Ann. Rept. Smithson. Inst. for year ending June 30, 1901, pp. 667–678, pls. 1–4.

1902. Howard, L. O. Note on Termes flavipes. Proc. Ent. Soc. Wash., vol. 5, No. 1, p. 5. (Believes true queen occurs in *flavipes* colonies and will eventually be found.)

1902. Marlatt, C. L. The White Ant, U. S. Dept. Agric., Bur. Ent. Circ. No. 50, 8 pp., 4 fig., June 30. (Gives directions as to how damage to buildings by *Termes flavipes* can be prevented by using stone foundations and by the removal of decaying wood in the vicinity.)

1902. Schaeffer, C. Journ. N. Y. Ent. Soc., vol. 10, No. 4, p. 251, December. (Records finding true queen of *flavipes*)

1902. Wasmann, E. Zool. Jahrb. Syst., vol. 17, Heft 1, p. 123 (*Amitermes tubiformans* Buckley).

1903. Heath, Harold. The habits of California termites. Biol. Bull., vol. 4, no. 2, pp. 47–63, January.

1903. Hopkins, A. D. Insect Enemies of the Redwood. The Redwood. U. S. Dept. of Agric., Bur. of Forestry, Bull. No. 38, Wash., 1903. (pp. 39–40 immunity of redwood from attack by termites at Manila, P. I.)

1903. Silvestri, F. Termitidi e Termitofili dell' America Meridionale. Redia, vol. 1. Portici.

1904. Desneux, J. Isoptera, Fam. Termitidae, pp. 52, figs. 10, pls. 2. (Wytsman, P. "Genera Insectorum," fasc. 25, Bruxelles.)

1904*a*. Desneux, J. A Propos de la Phylogénie des Termitides, p. 278. Annales Société Entomologique Belgique, Bruxelles, vol. 48 (1904), p. 286. "Trois Termites Nouveaux," p. 288. *Termes tenuirostris.* "Phylogenie et la Division Systématique des Termitides," p. 372 (reply to Wasmann; systematic classification based on winged adults or soldiers).

1904. Jacobson, G. Zur Kenntnis der Termiten Russlands, Ann. du Mus. Zool. de l' Acad. imp. des scis., vol. 9, pp. 57–107, St. Petersburg. (p. 57 only two termites native in Europe, *Calotermes flavicollis* Fabricius ("Portugal, Spanien, der Provence, Toskana, Neapel, Sardinien, Sizilien, Nordafrika, Syrien, Kleinasien, und dem nordwestlichen Kaukasus—und *Termes lucifugus*—Portugal, Spanien, der Provence, La Rochelle, Paris, Langres, Toskana, Sizilien, Nordafrika, Dalmatien, der Türkei, Griechenland, Cypern, Bessarabien, und Odessa.")

1904. Wasmann, E. Phylogénie et la Division Systématique des Termitides. Annales Société Entomologique Belgique, Bruxelles, vol. 48, p. 370 (criticism of J. Desneux's views of the division of the old genus *Termes*, subdivisions established by soldiers).

1905. Desneux, J. Variétés Termitologiques II, Termites du Texas. Ann. Soc. Ent. Belg., vol. 49, Bruxelles.

1906. Banks, N. Entomological News, vol. 17, No. 9, pp. 336–7. Philadelphia, Pa. (*Termopsis laticeps* and *Cryptotermes cavifrons* described).

1906. Holmgren, N. Studien über südamerikanische Termiten. Zool. Jahrbuch. Abteil für Systematik, Geographie und Biologie der Thiere, vol. 23, Heft 5, Jena.

1907. Banks, N. Catalogue of Neuropteroid Insects (except Odonata) of the United States, pp. 5–6. (List of known North American termites.)

1907*a*. Banks, N. A new species of Termes. Ent. News, vol. 18, no. 9, Nov. (*Termes virginicus* described.)

1907. Berensberg, H. von P. Uses of insects as food, delicacies, medicines, or in manufactures. Natal Agr. Journ. and Min. Rec., vol. 10 (1907), no. 7, pp. 757–762, pl. 1 (Termites, etc.).

1907. Heath, H. The longevity of members of the different castes of Termopsis angusticollis. Biol. Bull., vol. 13, no. 3, pp. 161–164, August.

1908. Handlirsch, A. Die fossilen Insekten und die Phylogenie der rezenten Formen, pt. 8, p. 1240, Leipzig.

1908. Kellogg, V. L. American Insects, chap. 7, New York (Notes on *Termopsis angusticollis*).

1909. Banks, N. Directions for collecting and preserving insects, pp. 135, figs. 188, Washington, U. S. Nat. Mus. Bull. 67. Platyptera, pp. 6–7.

1909. Holmgren, N. Termitenstudien 1. Anatomische Untersuchungen. K. Svenska Vetensk. Akad. Handl., vol. 44, No. 3, pp. 215, pls. 1–3, Uppsala and Stockholm, 1909. Die Verwandtschaftsbeziehungen der Termiten, pp. 208–213.

1909. Knab, F. Luminous Termite Hills. Science, n. s., vol. 30, no. 773, Oct. 22, pp. 574–575. (In the Amazon region, in the vicinity of Santarem, Brazil, termite hills are luminous at night.)

1910. Holmgren, N. Versuch einer Monographie der amerikanischen Eutermes-Arten. Mitteil. Naturh. Mus. Hamburg, vol. 27, p. 237 (*Eutermes*).

1910. Montandon, A. L. A propos des soi-disant neutres chez les insectes. Bull. Soc. Române de Ştiinte, vol. 19, nos. 1–2, pp. 444–452. Bucharest. (Records an instance of an old male rabbit which castrated young rabbits by depriving them of their testicles by biting. M. Montandon attributes the reason: "Pour évincer une concurrence qui paraît-il commençait à le gêner." He generalizes: "Et pourquoi refuserait -on aux termites, aux fourmis et abeilles sociales, d'avoir eux aussi trouvé la clef de ce mystère.")

1911. Bowman, I. Forest Physiography, New York. (Maps of regions of United States.)

1911. Holmgren, N. Termitenstudien 2. Systematik der Termiten. K. Svenska Vetensk. Akad. Handl., vol. 46, no. 6, pp. 86, pls. 1–6, Uppsala and Stockholm, 1911. Ordnung Isoptera, pp. 10–11.

1911. Strickland, E. H. A quiescent stage in the development of Termes flavipes Kollar. Journ. N. Y. Ent. Soc., vol. 19, no. 4, Dec., pp. 265–269. (Noted quiescent stages during molt of nymphs of the first form.)

1912. Escherich, K. Termitenleben auf Ceylon. Verlag v. Gustav Fischer, Jena. (Describes apparatus and methods of combating termites by the use of poison gases, i. e., fumigating their galleries and nests in the ground by forcing poison fumes into them with a pump, and how their presence can be detected at great depths in the earth and in infested houses by the use of the microphone; this is particularly interesting in view of the use made of poison gases in trench warfare and of the microphone by submarines at sea to detect the presence of destroyers; also its use by sappers in countermining operations listening for digging by the enemy in the great world war.)

1912. Feytaud, J. Contribution à l'étude du termite lucifuge. Arch. Anat. Micros., vol. 13, fasc. 4, pp. 481–606, figs. 34, 30 juin.

1912. Fuller, C. Dept. Agric., Union of South Africa, No. 54. (Agric. Journ. Union South Africa, Sept. and Oct., 1912.) (p. 22, "Universal ant exterminator", to fumigate nests in the ground; in South Africa use mixture 7 lbs. arsenic to 3 lbs. sulphur, or 2 lbs. sulphur to 8 lbs. arsenic; results relatively the same when the sulphur proportion is reduced; in Philippine Islands use proportion 3 sulphur to 1 arsenic.)

1912. Holmgren, N. Termitenstudien 3. Systematik der Termiten. Die Familie Metatermitidae. K. Svenska Vetensk. Akad. Handl., vol. 48, no. 4, 166 pp., pl. 1; Uppsala and Stockholm, 1912. Blick auf dem mutmasslichen, stammesgeschichtlichen Entwicklungsverlauf der Termiten, pp. 129-153.

1912*a*–1913. Holmgren, N. Termitenstudien 4. Vesuch einer systematischen Monographie der Termiten der orientalischen Region. K. Svenska Vetensk. Akad. Handl., vol. 50, no. 2, 276 pp., pls. 8. Uppsala and Stockholm. (Subgenus *Reticulitermes* established under the genus *Leucotermes* Silvestri.)

1912. Snyder, T. E. Record of the finding of a true queen of Termes flavipes Kol. Proc. Ent. Soc. Wash., vol. 14, no. 2, pp. 107–108, June 19.

1913. Assmuth, J. Wood-destroying white ants of the Bombay presidency. Journ. Bombay Nat. Hist. Soc., vol. 22, no. 2, pp. 372–384, 4 pls., Sept. 30. ("Frassbilder," how to determine genus of termites by burrows in wood.)

1913. BAILEY, V. Life zones and crop zones of New Mexico. North Amer. Fauna, No. 35, U. S. Dept. Agric., Bur. Biol. Survey, Wash., Sept. 5.

1913. JACK. R. W. Termites or white ants. Dept. Agric., Bull. No. 139. Salisbury, Rhodesia. Feb., 1913. (Chemical preservative treatments and resistant woods. Zinc ant course—strips of zinc laid on the first course of bricks over the whole foundations and projecting at least 1 inch on each side of the wall, thus effectively preventing termites from ascending the wall.)

1913. SILVESTRI, F. Descrizione di un nuovo ordine di insetti. Boll. Lab. Zool. Portici, vol. 7, pp. 193–209.

1913. SNYDER, T. E. Changes during quiescent stages in the metamorphosis of termites. Proc. Ent. Soc. Wash., vol. 15, no. 4, pp. 162–165, pls. 6–7, Dec. (Noted changes during the molting of nymphs of the first and second form and soldiers.)

1913. WHEELER, W. M. Ants, their structure, development and behavior. pp. 1–663. New York. (Relations between ants and termites.)

1914. BARBER, H. G. Another queen of the white ant found. Journ. N. Y. Ent. Soc., vol. 22, no. 1, p. 73, Mar.

1915. BRYAN, W. A. Natural history of Hawaii. Honolulu, Hawaii, 1915, termites, p. 402. *Calotermes marginipennis* (introduced species); C. *marginipennis*, p. 425; *C. castaneus* (Hawaiian species), p. 425.

1915. J. M. C. (Commonwealth of Australia, Postmaster General's Dept., Electrical Engineer's Branch, Melbourne.) "Construction," pp. 274–281. "The Ravages of the White Ant." (Damage to lead-covered cable laid in wood (Jarrah) troughing, Melbourne, 1915; conduit laid in December, 1906, affected cable drawn in, in February, 1907; damage first revealed in September, 1911. The lead sheathing was badly eaten for a distance of 20 feet. The termite was *Termes australia.*[1] The author also refers to the utilization by Australians of the brown excretion in the nest structure of mound building termites for tennis courts.)

1915. DILLER, J. S. (and others). Guidebook of the Western United States, pt. D, The Shasta Route and Coast Line, Dept. of the Interior, U. S. Geol. Survey Bull. 614, 142 pp., Wash. (Geographic and geologic descriptive data.)

1915. EHRHORN, E. M. Entomological Notes. Proc. Hawaiian Ent. Soc., vol. 3, No. 2, pp. 55–56, July. (*Coptotermes*, species damaging Douglas fir timber supporting band stand in capitol grounds, Honolulu; timbers largely destroyed.)

1915. FULLER, C. Observations on some South African termites. Ann. Natal Museum, vol. 3, pt. 2, Oct. (Peculiar mating habits of *Termes natalensis T. latericius*, and *T. vulgaris*, i. e., the calling attitude of the females on grass stems by violently agitating their wings.)

1915. LEE, W. T., STONE, R. W., GALE, H. S., and others. Guidebook of the Western United States, pt. B, The Overland Route. Dept. of the Interior, U. S. Geol. Survey Bull. 612, 244 pp., Wash.

1915. HILL, G. F. Northern Territory Termitidae, pt. 1, Proc. Linnaean Soc. N. S. Wales, vol. 40, pt. 1, No. 157, pp. 83–113. (p. 110, larva of a Tachinid fly predacious on *Rhinotermes*.)

1915. HOZAWA, S. Revision of the Japanese Termites. Journ. Col. of Sci., Tokyo Imper. Univ., vol. 35, art. 7, April 30, p. 82. (*L. flavipes* not found in Japan.)

1915. SNYDER, T. E. Biology of the termites of Eastern United States, with preventive and remedial measures. Bur. Ent. Bul. 94, pt. 2, U. S. Dept. Agric., Feb.

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[1] *australis* Walker?

1915. Yano, M. White Ants in Japan. Extracts from the Bulletin of the Forest Exp. Station, Meguro. Bureau of Forestry, Dept. of Agric. and Commerce, Tokyo, Japan.

1916. Jennings, W. S. Royal Palm State Park. The Tropic Magazine, vol. 4, no. 1, April, pp. 10–16, 26. (Florida Everglades.)

1916. Merrill, J. H., and Ford, A. L. Life history and habits of two new Nematodes parasitic on insects. Journ. Agric. Research, Dept. Agric., vol. 6, no. 3, April 17, Wash.

1916. Simpson, C. T. Paradise Key (Florida Everglades). The Tropic Magazine, vol. 4, no. 1, April, pp. 5–9.

1916. Small, J. K. Royal Palm Hammock (Paradise Key). Journ. N. Y. Botanical Garden, vol. 17, pp. 165–172, March. (Describes the Everglade Keys.)

1916. Snyder, T. E. Termites or "white ants" in the United States: Their damage and methods of prevention. U. S. Dept. Agric. Bull. 333, Feb.

1916*a*. Snyder, T. E. White ants as pests in the United States, and methods of preventing their damage. U. S. Dept. Agric., Farmers' Bulletin 759, October.

1916. Thompson, C. B. The brain and frontal gland of the castes of the "white ant" Leucotermes flavipes Kollar. Journ. Compar. Neurology, vol. 26, no. 5, Oct. (Very little differentiation between the brains of the castes, none between the sexes; most marked difference being in the optic apparatus, etc.; the frontal gland may have arisen phylogenetically from the ancestral median ocellus, now lacking, etc.; term "nymph" used to denote any developmental stage, whether possess wing pads or not.)

1916. Van Zwaluwenburg, R. H. Rept. Porto Rico Agric. Exp. Sta., Wash., D. C. Nov., 1916. Rept. of the Entomologist. (Furniture and woodwork in houses damaged by *Eutermes morio* and "*Leucotermes*"; the former cheaply and effectively controlled by placing liberal quantities of any powdered arsenical poison in the runways and nests. London purple gives quicker results than Paris green, probably owing to the finer division of the particles. *Leucotermes* most effectively controlled by fumigation with hydrocyanic acid.) ("*Leucotermes*" = *Cryptotermes*.)

1916. Grand Rapids Public Library (Mich.) 45th Ann. Rept., April, p. 59 (termite damage to book cases, books; ammonia effective in killing exposed termites).

1917. Kofoid, C. A., and Swezy, O. Studies of the Parasites of Termites. I–IV. 116 pp., 14 pls., 8 figs. University of California Press. June.

1917. Lutz, F. E., and Rehn, J. A. G. Notes on collecting in Arizona in 1916 with descriptions of the region. Journ. New York Ent. Soc., vol. 25, no. 2, pp. 142–3, June. Desert slopes with mesquite and Opuntia, 2,200 to 2,500 feet; desert slopes with "Palo Verde" and Cereus 3,500 feet; desert slopes with Yucca and Agave 4,500 feet.

1917. Petch, T. Notes. Spolia Zeylanica Colombo Museum, Ceylon, vol. 10, pt. 39, pp. 395–7. Note on the emergence of winged termites *Termes obscuriceps* Wasmann(narrowing of exit at midday by workers preparatory to emergence of winged adults—5.57 p. m.—main flight 13 minutes. Narrowing exit usual in Ceylon mound-building termites—facilitates closing after flight? Soldiers and workers around exits to protect winged insects—to close exit. Return of deälated male and female to nests, apparently before fertilization of female).

1917. Richards, P. B. The history and present position of White Ant treatment in Malaya, p. 75. Proc. First Agric. Conference, Malaya Kuala Lumpur, Agric. Bull. Federated Malay States, vol. 5, Nos. 8 and 9. (*Termes gestroi* damage to rubber and cocoanut.) (Clean clearing—remove timber in which termites breed; nest in old logs and stumps—the most effective method of eradicating this species of termite and preventing damage to rubber and cocoanut trees.)

1917. Thompson, C. B. Origin of the castes of the common termite Leucotermes flavipes Kol. Journ. Morphology, vol. 30, No. 1, Dec. (Proves that the so-called "undifferentiated" nymphs are structurally differentiated, the fertile and sterile types being predetermined at the time of hatching; suggested terms adults first, second, and third forms, respectively, for the forms with wings or wing pads, and those with no wing pads, instead of the present heterogeneous nomenclature.)

1918. Banks, N. The termites of Panama and British Guiana. Bull. Amer. Mus. Nat. Hist., vol. 38, Art. 17, pp. 659–67. New York, Nov. 29.

1918. Beebe, W. Jungle Peace. New York. (Termites are immune to attack by army ants in the Tropics.)

1918. Berger, E. W. Termite Injury to Sweet Potatoes. Quarterly Bull. State Plant Board of Florida, vol. 2, no. 4, pp. 190–1, fig. 89. July, Gainesville.

1918. Brown, W. H. The Fungi Cultivated by Termites in the Vicinity of Manila and Los Baños. Philippine Journ. Sci. C. Botany, vol. 13, no. 4, pp. 223–231, pls. 3 and 4. July. (Bibliographical references.)

1918. Caudell, A. N. Zorotypus hubbardi, A New Species of the Order Zoraptera from the U. S. Canadian Entomologist, vol. 50, no. 11, pp. 375–81. Nov.

1918. Cleland, J. B. The Food of Australian Birds. Dept. Agric. New So. Wales, Science Bull. no. 15, July. (p. 15, Species of birds feeding on white ants.)

1918. Comstock, J. M. The wings of insects. Ithaca, N. Y. (chap. 8, pp. 132–144. The wings of Isoptera—*Mastotermes*, *Termopsis*, and *Leucotermes flavipes*.)

1918. Dobson, R. J. A European termite Reticulitermes lucifugus Rossi in the vicinity of Boston. "Psyche," vol. 25, No. 5, Oct., 1918.

1918. Hopkins, A. D. Periodical events and natural law as guides to agricultura research and practice. Monthly Weather Review Supplement No. 9, Weather Bureau, no. 643, U. S. Dept. of Agric., May 1.

1918. Wheeler, W. M. A study of some ant larvae, with a consideration of the origin and meaning of the social habit among insects. Proc. Amer. Philos. Soc., vol. 57, no. 4, pp. 293–343, Phila. (Trophallaxis—i. e., "exchange of nourishment"—originally developed as a mutual trophic relation between the mother insect and her larval brood, has expanded with the growth of the colony like an ever-widening vortex till it involves, first, all the adults as well as the brood and therefore the entire colony; second, a great number of species of alien insects that have managed to get a foothold in the nest as scavengers, praedators, or parasites (symphily); third, alien social insects—i. e., other species of ants (social parasitism); fourth, alien insects that live outside the nest and are "milked" by the ants (trophobiosis); and, fifth, certain plants which are visited or sometimes partly inhabited by the ants (phytophily). Trophallaxis is the source of the social habit in wasps and termites as well as in ants.)

1919. Banks, N. Antillean Isoptera. Bull. Mus. Compar. Zool., Harvard Col., vol. 62, no. 10, pp. 475–489.

1919. Bradley, J. C. An Entomological Cross-Section of the U. S. pts. 1 and 2. The Science Monthly, vol. 8, nos. 4 and 5. April to May. (Localities where Prof. Wheeler collected termites described.)

1919. Crampton, G. C. Notes on the Phylogeny of the Orthoptera. Ent. News, vol. 30, no. 2, pp. 42–48, Feb. No. 3, pp. 64–72, March. (Refers to Isoptera and Zoraptera.)

1919. Snyder, T. E. Some Significant Modifications in Nearctic Termites. Proc. Ent. Soc., Wash., vol. 21, no. 5, pp. 97–104, May.

1919*a*. Snyder, T. E. White Ants as Pests in the United States and Methods of Preventing their Damage. Farmers' Bull. 1037, U. S. Dept. Agric. June.

1919. Thompson, C. B., and Snyder, T. E. The question of the phylogenetic origin of the termite castes. Biological Bulletin, Woods Hole, Mass., vol. 36, No. 2, pp. 115–132, Feb. (Discusses phylogeny, morphology, and the breeding and progeny of the three different reproductive forms.)

1919. Safford, W. E. Natural History of Paradise Key. Ann. Rept. Smithsonian Institution for 1917, pp. 377–434. (Describes fauna and flora of Royal Palm Hammock.)

1919. Thompson, C. B. The Development of the Castes of Nine Genera and Thirteen Species of Termites. Biol. Bull., vol. 36, no. 6, pp. 379–398, June.

EXPLANATION OF PLATES.

PLATE 1.

FIG. 1. *Cryptotermes infumatus*, wing and pronotum.
2. *Reticulitermes flavipes*, venter of male and female.
3. *Amitermes* (?) *perplexus*, maxilla and right jaw of worker.
4. *Amitermes tubiformans*, maxilla and right jaw of worker.
5. *Anoplotermes fumosus*, maxilla and right jaw of worker.
6. *Constrictotermes tenuirostris*, maxilla and right jaw of worker.
7. *Constrictotermes*, gula of adult.
8. *Amitermes*, gula of adult.
9. *Nasutitermes*, gula of adult.
10. *Leucotermes*, gula of adult.
11. *Prorhinotermes*, gula of adult.
12. *Reticulitermes*, gula of adult.
13. *Termopsis*, gula of adult.
14. *Kalotermes*, gula of adult.
15. *Cryptotermes cavifrons*, right jaw of soldier.

PLATE 2.

FIG. 1. *Kalotermes marginipennis*, venation of fore wing. X 12.
2. *Kalotermes schwarzi*, venation of fore wing. X 12.
3. *Kalotermes minor*, venation of fore wing. X 14.
4. *Kalotermes hubbardi*, venation of fore wing. X 12.

PLATE 3.

FIG. 1. *Neotermes castaneus*, venation of fore and hind wings. X 12.
2. *Cryptotermes cavifrons*, venation of fore and hind wings. X 17.

PLATE 4.

FIG. 1. *Prorhinotermes simplex*, venation of fore wing. X 16.
2. *Anoplotermes fumosus*, venation of fore and hind wings. X 13.

PLATE 5.

Reticulitermes flavipes.

Earthlike shelter tubes built over a brick wall in a dark basement of an infested building in Washington, District of Columbia. The termites were thus enabled to pass from one wooden floor to another over the impenetrable brick. (Flashlight.)

PLATE 6.

Coptotermes, species.

Damage to lead sheathing of underground cable and perforations in tarred parcelling. Gold Hill, Panama, October 29, 1916.

PLATE 7.

Amitermes wheeleri.

Dry hard wood of a dead mesquite tree honeycombed. Laguna, Texas.

PLATE 8.

The pro and meso thoracic tibiae of earth-inhabiting worker termites contrasted to show subfossorial prothoracic tibiae in some species.

FIG. 1. *Anoplotermes fumosus* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

2. *Amitermes tubiformans* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

3. *Amitermes arizonensis* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

4. *Amitermes californicus* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

5. *Amitermes wheeleri* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

6. *Constrictotermes tenuirostris* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

7. *Constrictotermes cinereus* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

8. *Reticulitermes flavipes* worker; prothoracic and mesothoracic tibiae contrasted. X 20.

PLATE 9.

Termopsis angusticollis.

Impressed pellets of excrement. South Pasadena, California.

PLATE 10.

Kalotermes, species.

Impressed pellets of excrement.

PLATE 11.

Neotermes castaneus.

Impressed pellets of excrement. X 5½.

PLATE 12.

Cryptotermes cavifrons.

Impressed pellets of excrement expelled from the mined wood.

PLATE 13.

Reticulitermes, species.

One of several shoes stored on wooden shelving in a building in North Carolina damaged by *Reticulitermes*, species.

PLATE 14.

FIG. 1. *Reticulitermes flavipes.* Root and stem of a geranium hollowed out. Enola, Virginia.

2. *Reticulitermes hesperus.* Work in the roots of sage brush. Elko, Nevada.

PLATE 15.

Reticulitermes hageni.

Bald cypress tree with buttressed base infested by *Reticulitermes hageni*, Lake Drummond, Virginia. These trees are in the lake surrounded by water.

PLATE 16.

FIG. 1. *Reticulitermes hesperus.* Worker infected with a parasitic fungous disease, Placerville, California.

2. *Termopsis angusticollis.* Work in western yellow pine, Placerville, California.

PLATE 17.

Kalotermes hubbardi.

Entrance holes of first form colonizing parent adults in dead cottonwood tree, Tucson, Arizona.

PLATE 18.

Map of the southern extremity of Florida showing hammocks and keys.

PLATE 19.

FIG. 1. Dry, seasoned painted woodwork—siding—of a business railway car damaged by *Kalotermes*, Los Angeles, California.

2. Block of ash wood used by Dudley and Beaumont in studying *Kalotermes* in Panama; a "ne plus ultra *Calotermitarium;*" the wood is *dry*.

3. *Cryptotermes cavifrons.* Longitudinal chambers excavated in dry, solid wood of a small branch of red mangrove, Adam Key, Florida.

PLATE 20.

Kalotermes hubbardi and *K. minor.*

Work in dead cottonwood tree, Tucson, Arizona.

PLATE 21.

Kalotermes hubbardi.

Cross section of cottonwood rafter of an "adobe" house mined by *Kalotermes hubbardi*, Tucson, Arizona, October 26, 1895.

PLATE 22.

Kalotermes hubbardi.

Longitudinal view of cottonwood rafter in "adobe" building mined by *Kalotermes hubbardi*, Tucson, Arizona. Note pellets of excrement in the burrows.

PLATE 23.

Neotermes castaneus.

Work in solid wood of aerial root of red mangrove (*Rhizophora mangle*), Miami Beach, Florida, March 1, 1919.

PLATE 24.

Prorhinotermes simplex.

Work in decaying log of red mangrove (*Rhizophora mangle*), Miami Beach, Florida, February 28, 1919.

PLATE 25.

Reticulitermes, species.

Timber in a building in New Orleans, Louisiana, reduced to the consistency of paper by *Reticulitermes*, species. Note how the termites have eaten the softer layers of wood and have left the harder.

FIG. 1. View of wood from top.

2. Side view showing the layers of harder wood.

PLATE 26.

Reticulitermes flavipes.

Damage to roll of paper labels stored in an infested building, Bloomfield, New Jersey.

PLATE 27.

Reticulitermes flavipes and *Nasutitermes morio.*

Photographs of longitudinal, microtome sections of the abdomens of the three different types of egg-laying queens of *Reticulitermes flavipes* to show the relative proportions of the abdomens taken up by eggs and ovaries; also in contrast that of a first-form queen of *Nasutitermes morio.* (After Thompson and Snyder.)

FIG. 1. Longitudinal section through body of an old first-form queen of *Reticulitermes flavipes.* X 20.
2. Longitudinal section through the body of a second-form queen (with distended abdomen) of *Reticulitermes flavipes.* X 20.
3. Longitudinal section through the body of an egg-laying third-form queen of *Reticulitermes flavipes.* The extent of the egg tubes is less than in the other two forms, but the ova shown happen to be in the oldest stage and are therefore larger. X 20.
4. Longitudinal section through the body of a mature first-form queen of *Nasutitermes morio.* X 20.

PLATE 28.

Reticulitermes flavipes and *Nasutitermes morio.*

Photomicrographs of longitudinal microtome sections through the abdomens of the three different types of egg-laying queens of *Reticulitermes flavipes*, contrasted with a first-form queen of *Nasutitermes morio.* The ripe eggs are the large oblong cells with yolk spheres; they occupy more space in the abdomen of the first form queens and the eggs are also more numerous. (After Thompson and Snyder.)

FIG. 1. View of a longitudinal section of an old first form queen of *Reticulitermes flavipes.*
2. View of a longitudinal section of a second form queen (with distended abdomen) of *R. flavipes.*

PLATE 29.

Photomicrographs of longitudinal microtome sections through the abdomens of the three different types of egg-laying queens of *Reticulitermes flavipes*, contrasted with a first form of *Nasutitermes morio.* The ripe eggs are the large oblong cells with yolk spheres; they occupy more space in the abdomen of the first form queens and the eggs are also more numerous. (After Thompson and Snyder.)

FIG. 1. View of a longitudinal section of an egg-laying third-form queen of *R. flavipes.*
2. View of a longitudinal section of a mature first-form queen of *Nasutitermes morio.*

PLATE 30.

FIG. 1. Second form reproductive individuals with wing pads of *Reticulitermes tibialis;* one king and three queens. Colorado Springs, Colorado. X 10.
2. *Reticulitermes flavipes.* Queen of the third form, one of seventeen from a large colony at Falls Church, Virginia. X 5.

PLATE 31.

Reticulitermes hesperus Banks.

Tentacle-like projections or tunnels constructed of excrement and earth across a concrete wall for a distance of 8 feet. The nucleus of the structure is the end of a beam set in the wall, and from it radiate several tunnels. Note the granular structure. Los Angeles, California. Courtesy *Popular Mechanics*, Dec., 1918.

PLATE 32.

Reticulitermes humilis, var. *hoferi.*

Work in the dry, solid, hard wood of an oak stump, Nogales, Arizona.

PLATE 33.

Amitermes tubiformans.

Grass and weeds covered with earth by this tube-forming termite in the prairie region Victoria County, Texas.

Fig. 1. *Amitermes tubiformans.* Grass and weeds covered by earthlike tubes, prairie region, Victoria, Texas, Oct. 8/17. J. D. Mitchell.

2. *Amitermes tubiformans.* Grass and weeds covered by earthlike tubes, prairie region, Victoria, Texas, Oct. 8/17. J. D. Mitchell.

3. *Amitermes tubiformans.* Grass and weeds covered by earthlike tubes, prairie region, Victoria, Texas, Oct. 8/17. J. D. Mitchell.

4. *Amitermes tubiformans.* Dry horse manure covered by tubes, prairie region, Victoria, Texas, Oct. 8/17. J. D. Mitchell.

5. *Amitermes tubiformans.* Sage weed covered by tubes, Victoria County, Texas, Sept. 24/18. J. D. Mitchell. (Collecting bag in background.)

PLATE 34.

Damage to Irish Cobbler potatoes by *Reticulitermes*, species at Dallas, Tex., July 3, 1919 (F. C. Bishopp.)

Fig. 1. Potato with tip broken off and turned back to show burrows where the potato was eaten out.

2. Lower $\frac{4}{5}$ of potato, bud end removed.

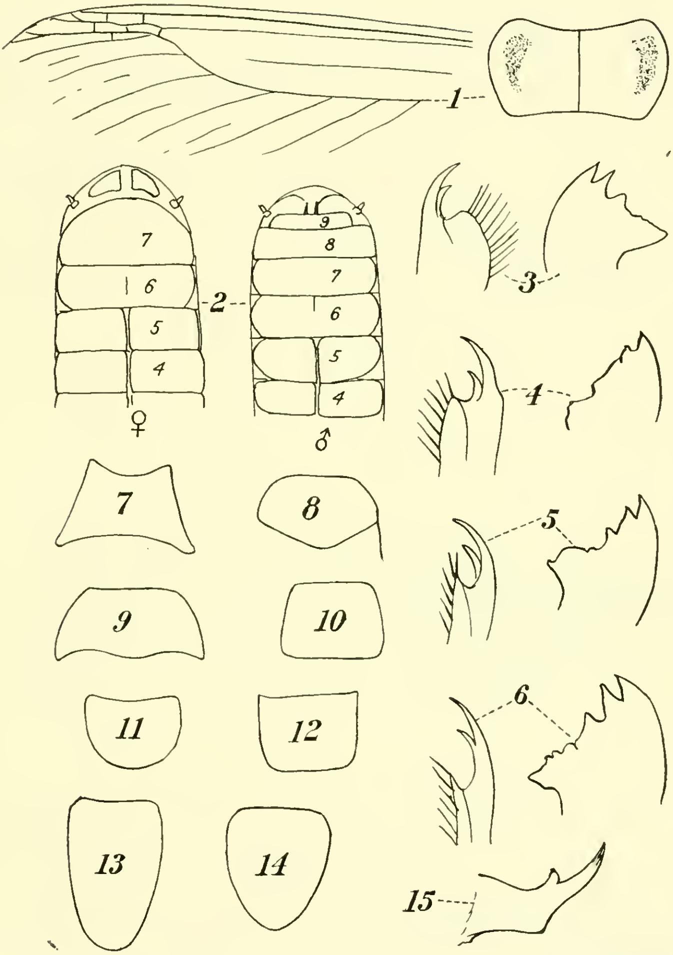
3. Entire potato with bud end infested uppermost.

PLATE 35.

Eggs of Nine Genera of Nearctic Termites.

		Subfamilies.
Fig. 1. *Termopsis angusticollis*	Family *Kalotermitidae*	*Termopsinae*
2. *Neotermes castaneus*		*Kalotermitinae*
3. *Kalotermes schwarzi*		
4. *Crypototermes cavifrons*		
5. *Prorhinotermes simplex*	Family *Termitidae*	*Rhinotermitinae*
6. *Reticulitermes flavipes*		
7. *Anoplotermes fumosus*		*Termitinae*
8. *Amitermes tubiformans*		
9. *Nasutitermes pilifrons*		

(Drawn by Miss C. B. Thompson, using Spencer occular 6, objective 32 mm.)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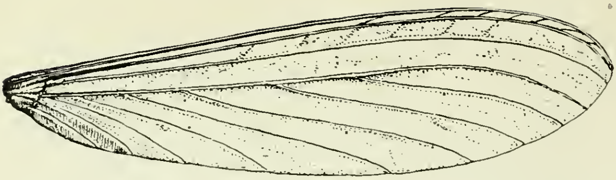
DETAILS IN STRUCTURE OF NEARCTIC TERMITES.

FOR EXPLANATION OF PLATE SEE PAGE 207.



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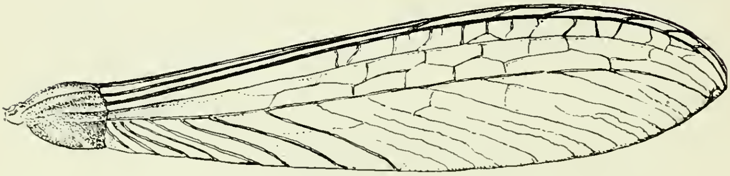

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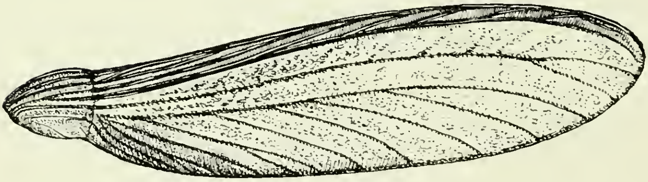

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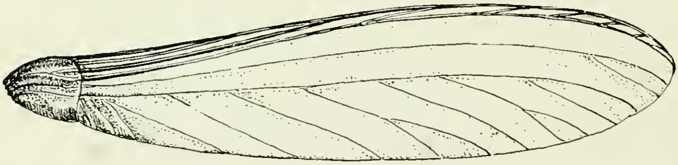

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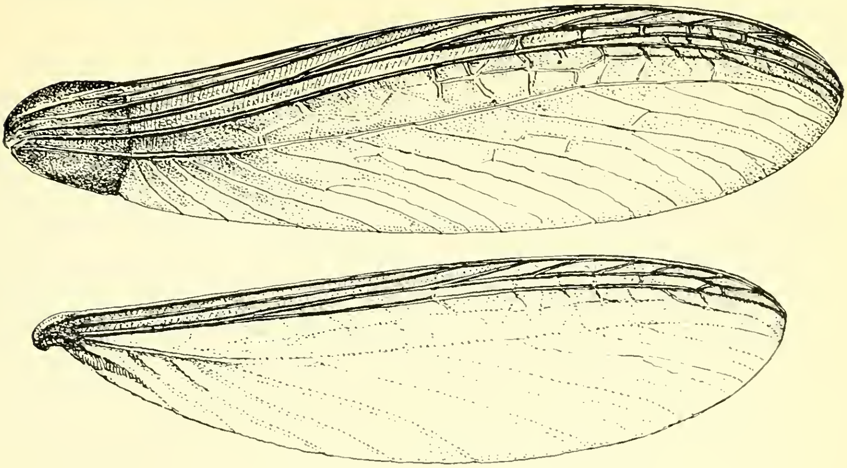
WING VENATION OF NEARCTIC KALOTERMITIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 207.



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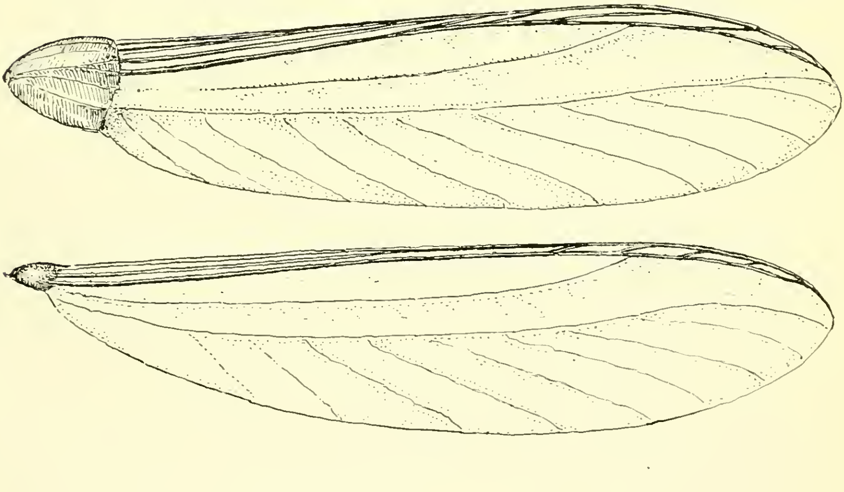

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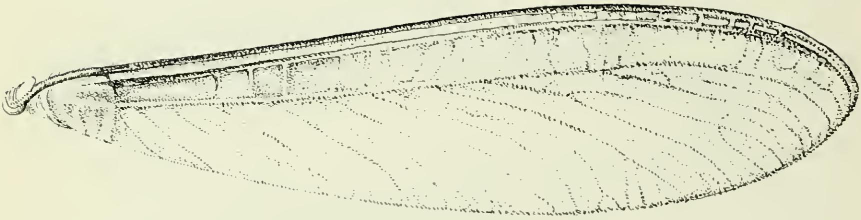
WING VENATION OF NEARCTIC KALOTERMITIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 207.



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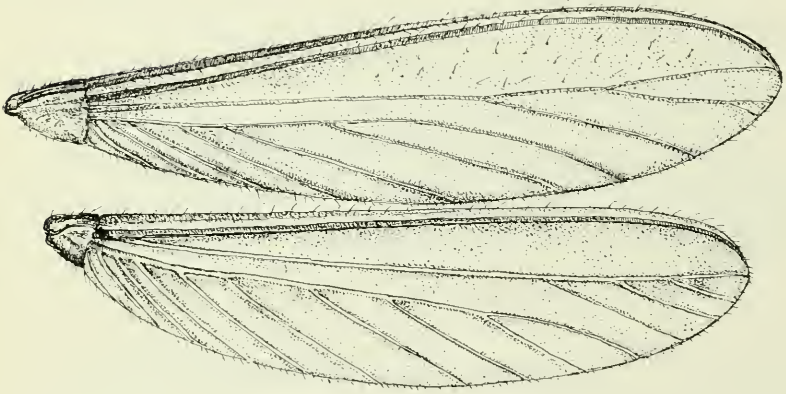

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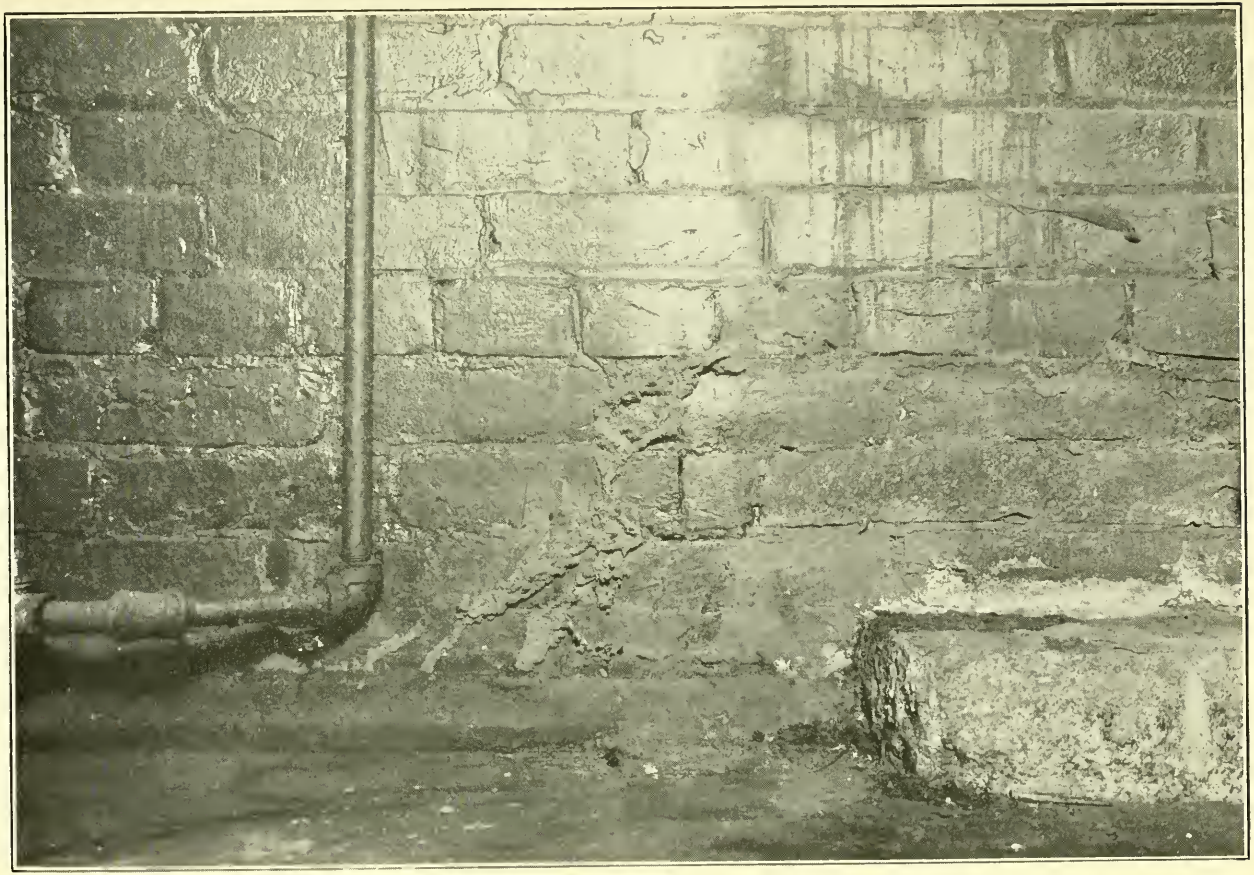
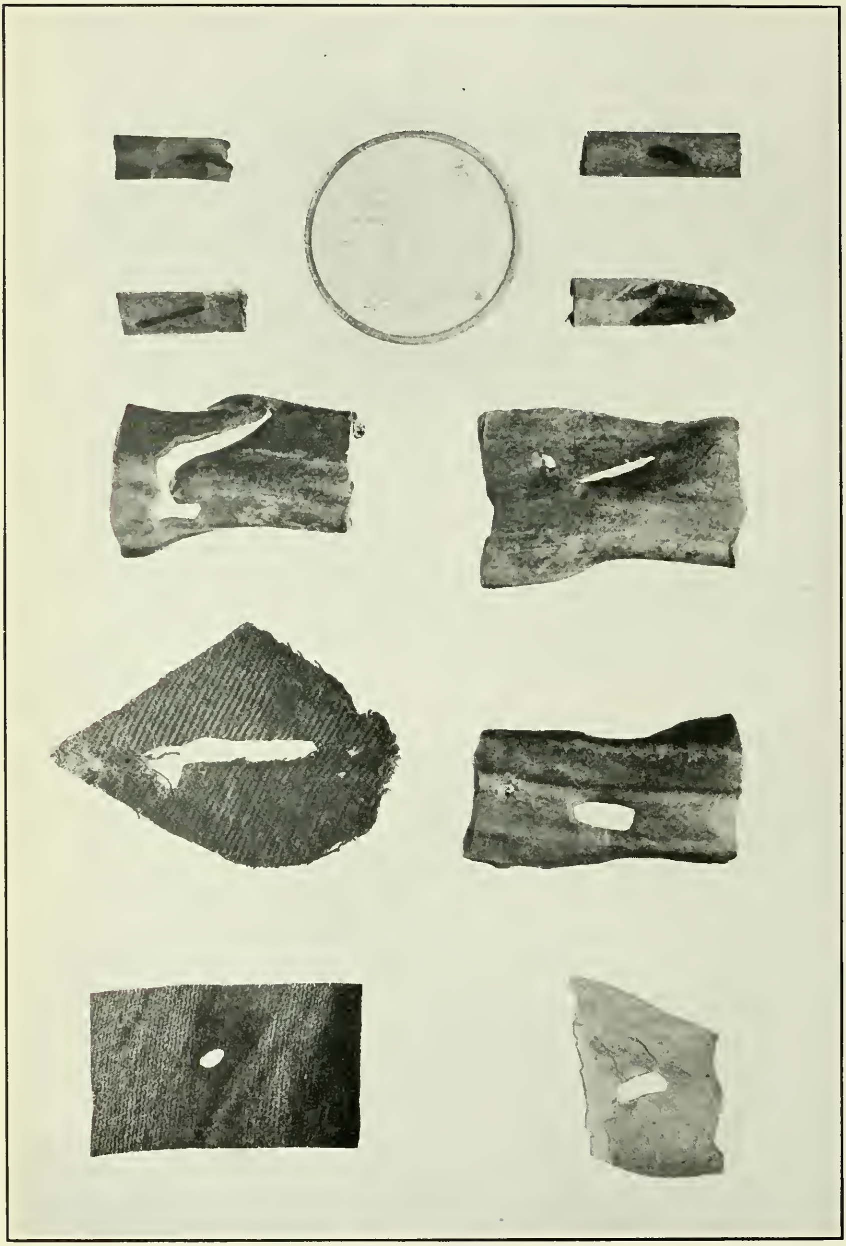
WING VENATION OF NEARCTIC TERMITIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 207.



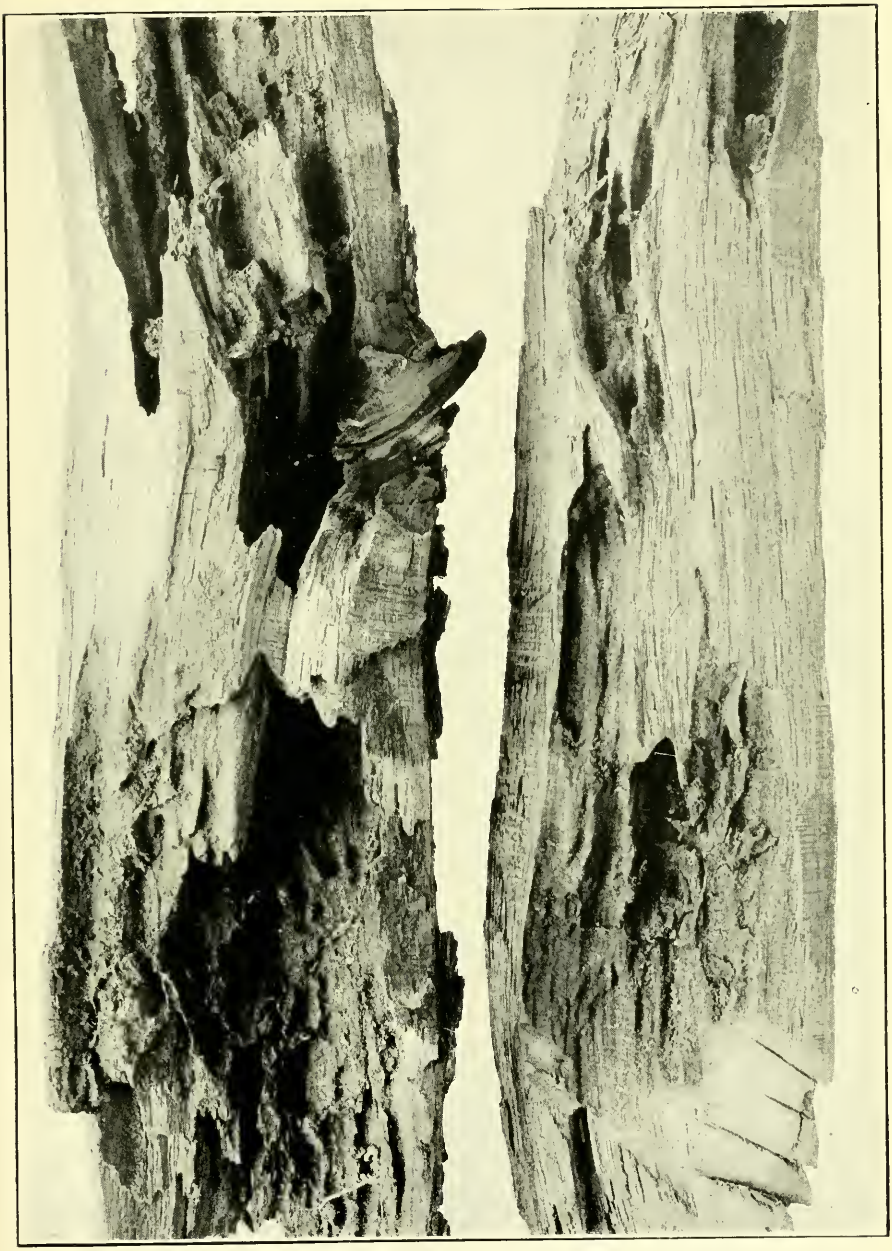
Shelter Tubes Built by Reticulitermes flavipes over Brick Wall, Washington City.

For explanation of plate see page 207.



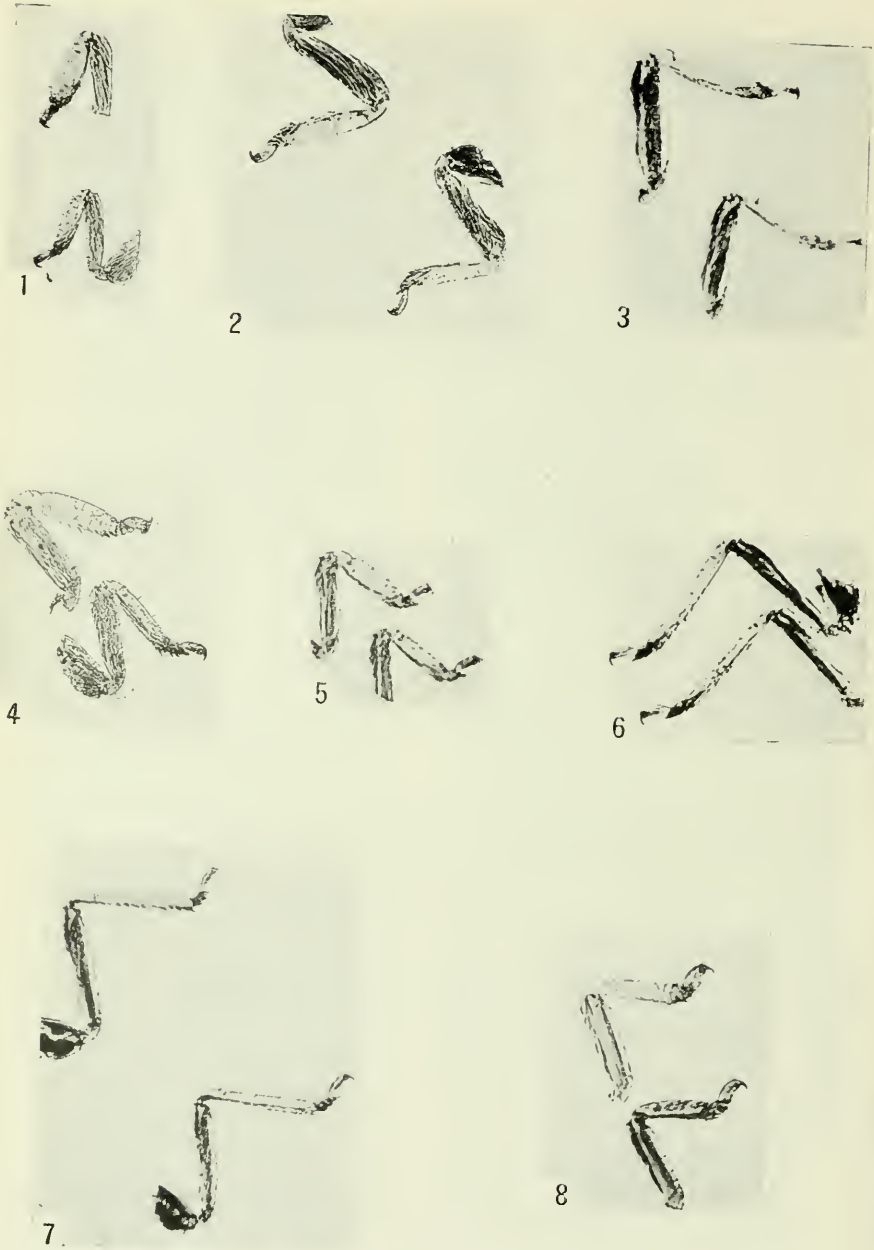
Lead Cable Sheathing Damaged by Coptotermes, species, in Panama.

For explanation of plate see page 207.



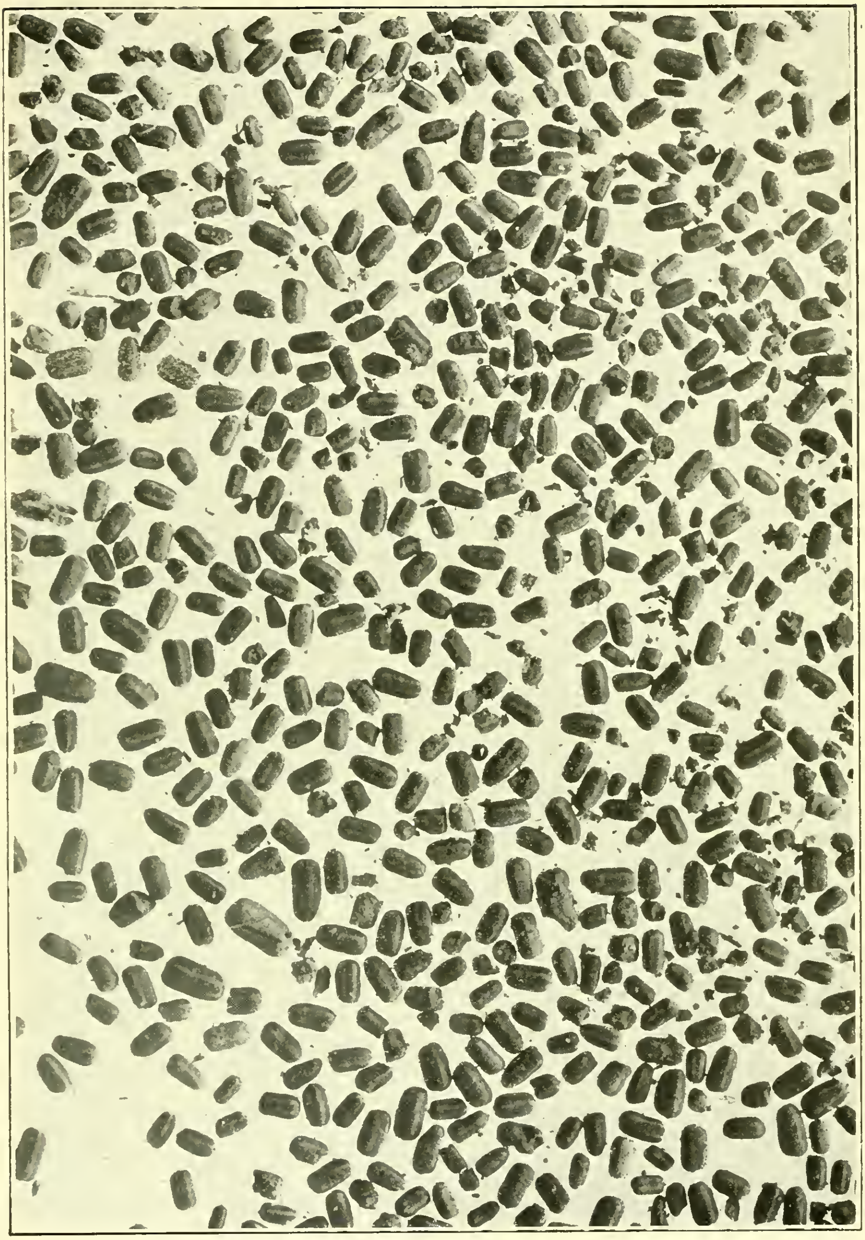
Dry Hardwood of Mesquite Honeycombed by Amitermes wheeleri in Texas.

For explanation of plate see page 207.



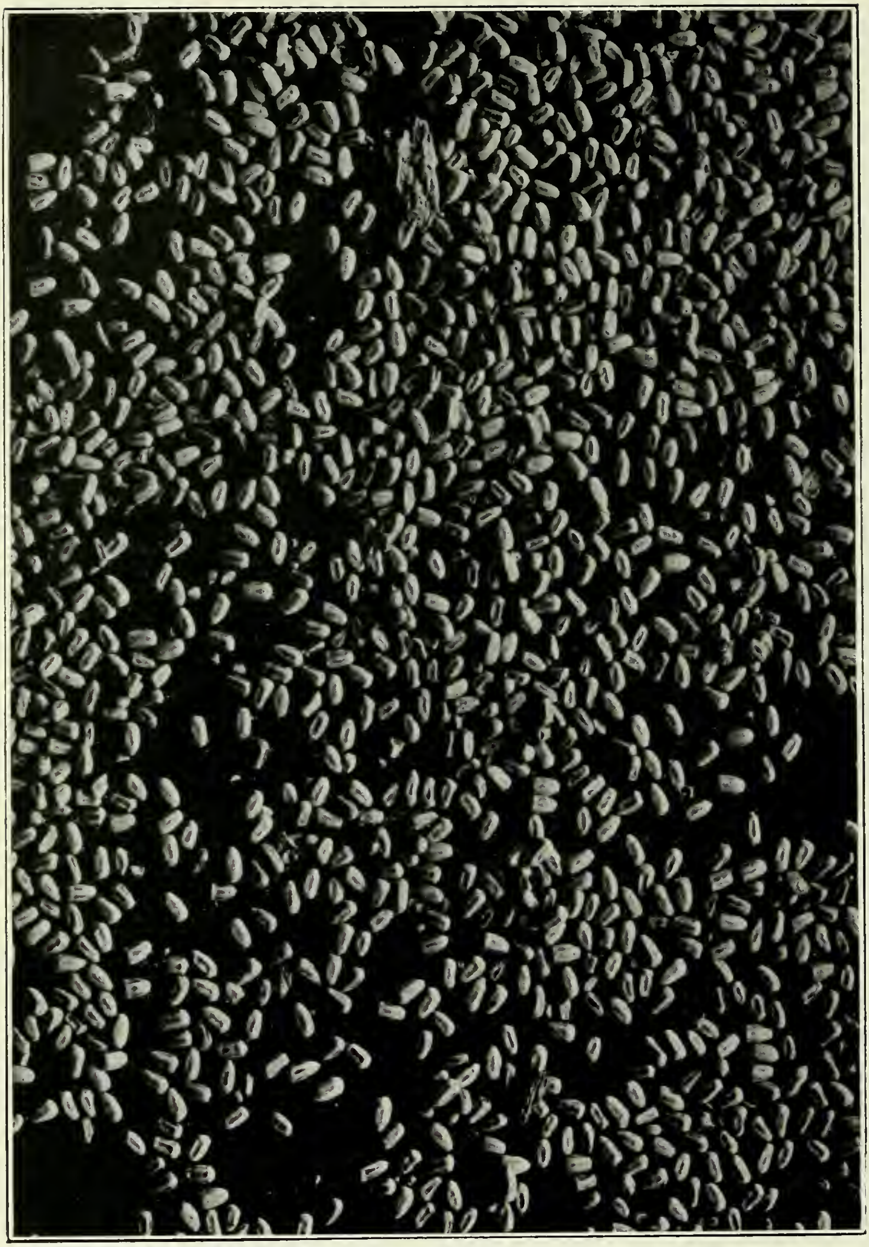
SUB-FOSSORIAL PROTHORACIC TIBIAE OF WORKERS OF NEARCTIC TERMITES.

FOR EXPLANATION OF PLATE SEE PAGES 207 AND 208.



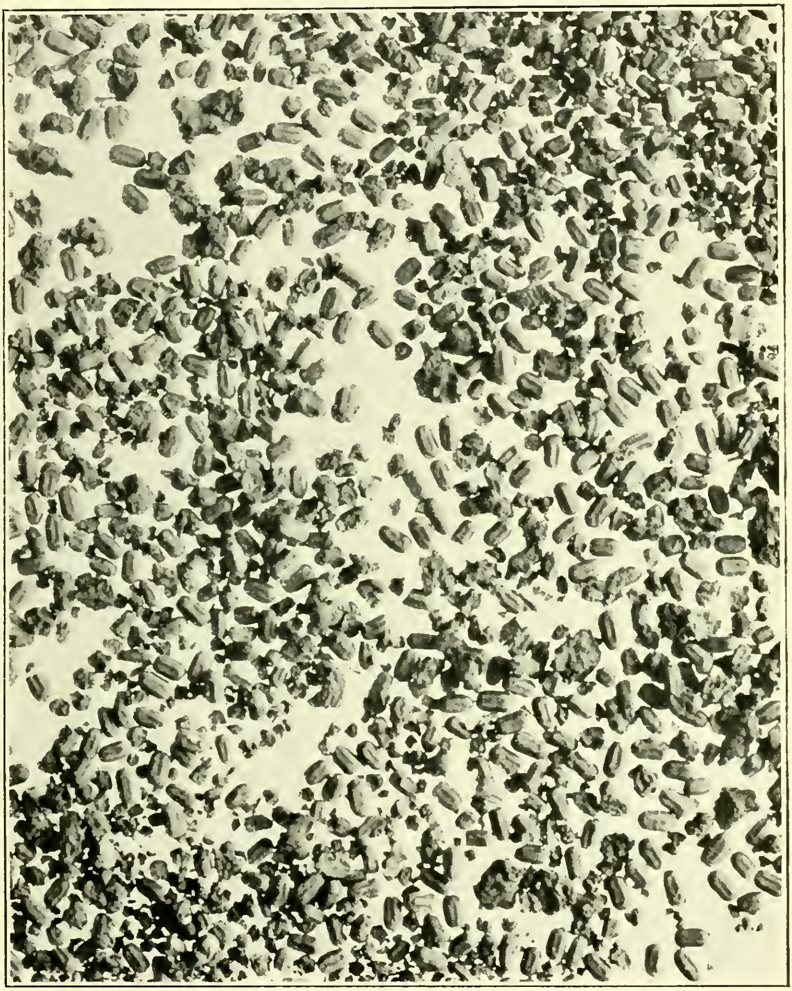
Impressed Pellets of Excrement of Termopsis angusticollis.

For explanation of plate see page 208.



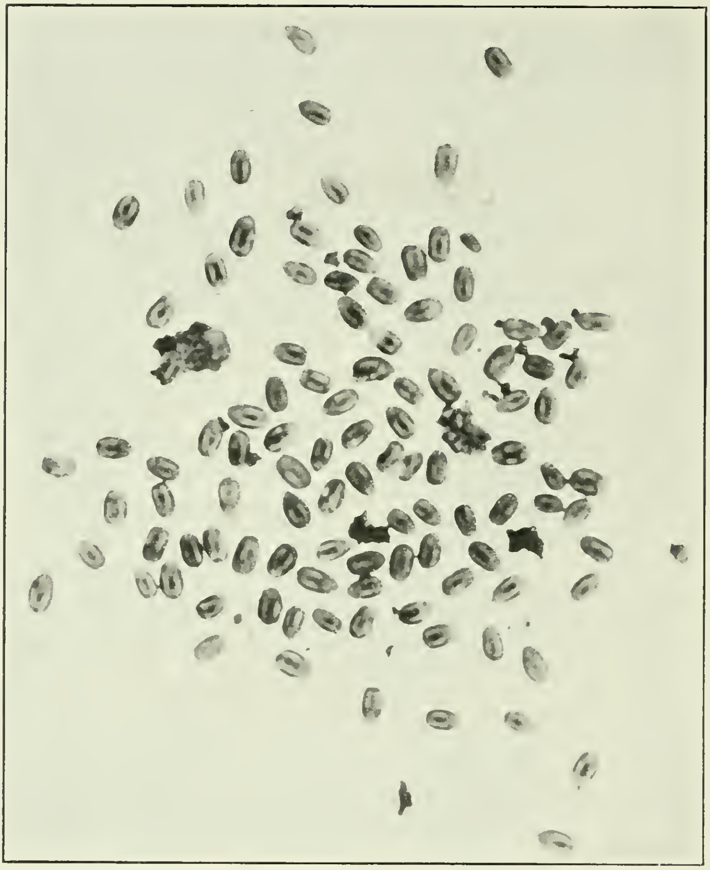
Impressed Pellets of Excrement of Kalotermes.

For explanation of plate see page 208.



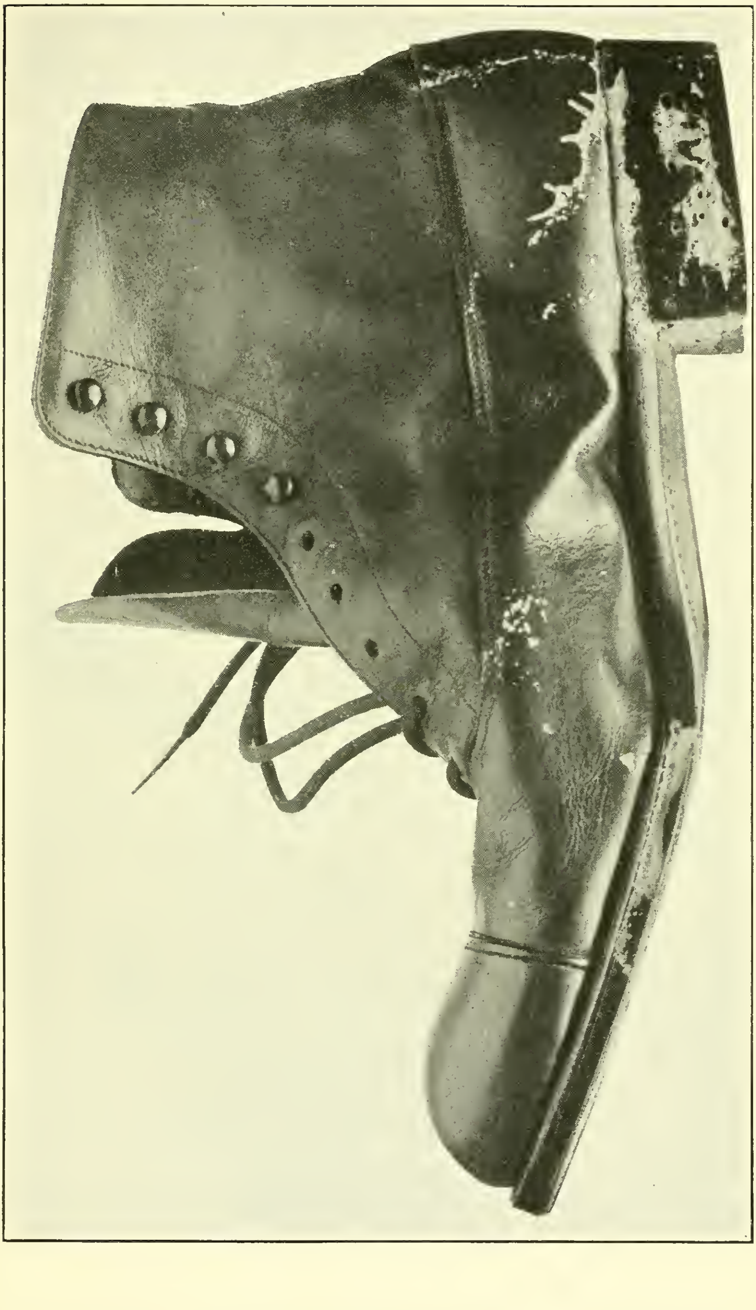
IMPRESSED PELLETS OF EXCREMENT OF NEOTERMES CASTANEUS.

FOR EXPLANATION OF PLATE SEE PAGE 208.



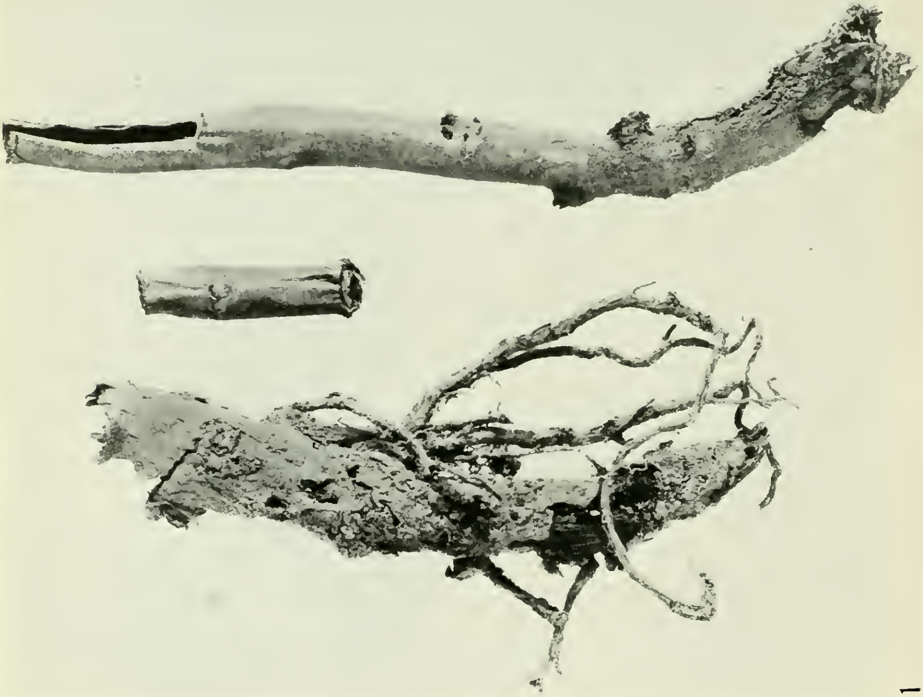
Impressed Pellets of Excrement of Cryptotermes cavifrons.

For explanation of plate see page 208.



Shoe Damaged by Reticulitermes in North Carolina.

For explanation of plate see page 208.



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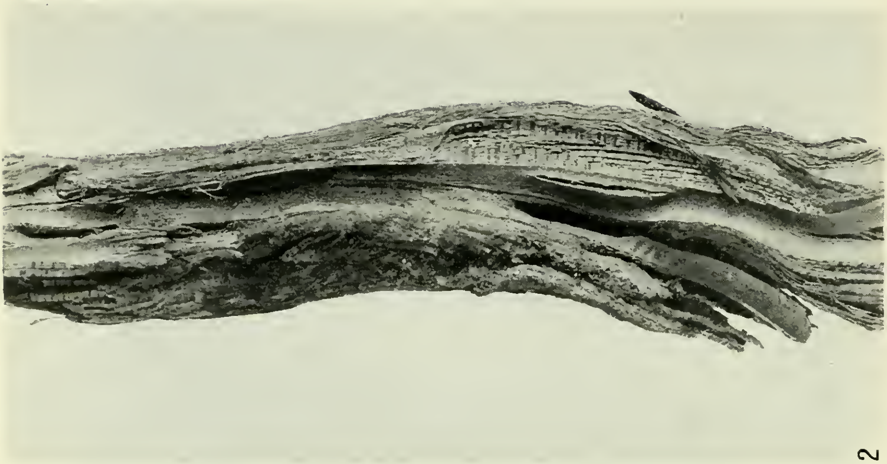

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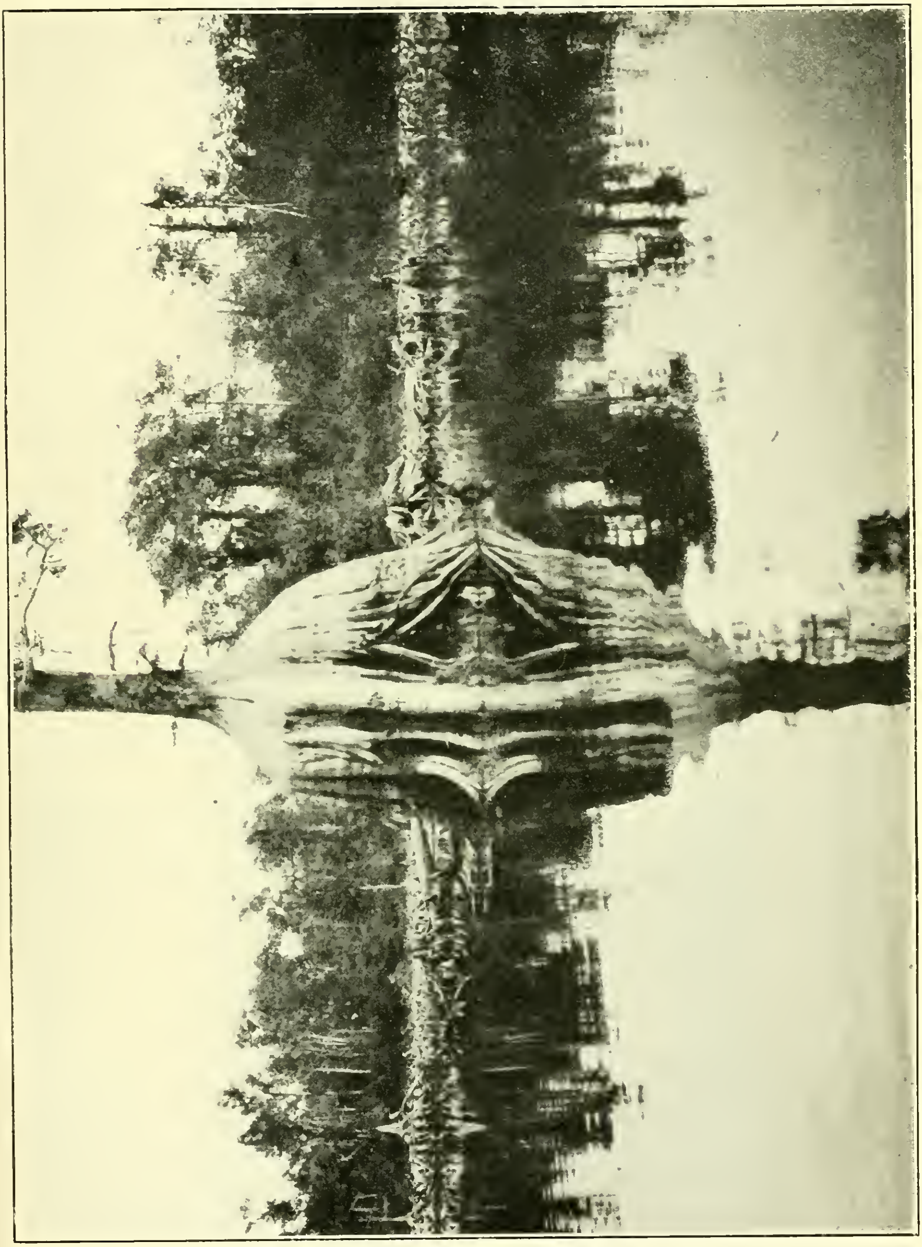
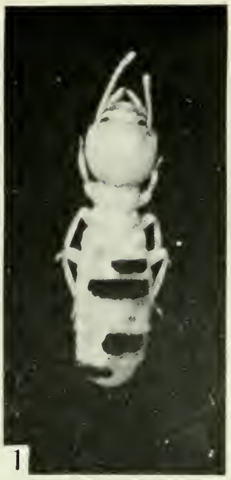
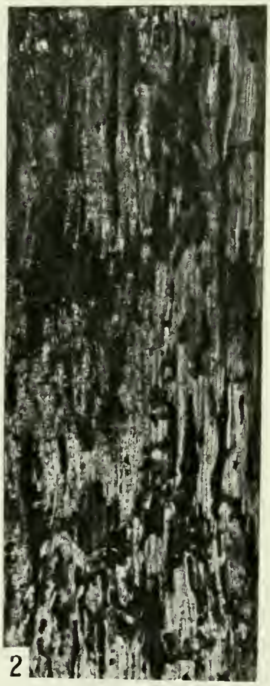
INJURY TO LIVING PLANTS BY RETICULITERMES.



BUTTRESSED BASE OF BALD CYPRESS TREE, DISMAL SWAMP, VIRGINIA, INFESTED BY RETICULITERMES HAGENI.

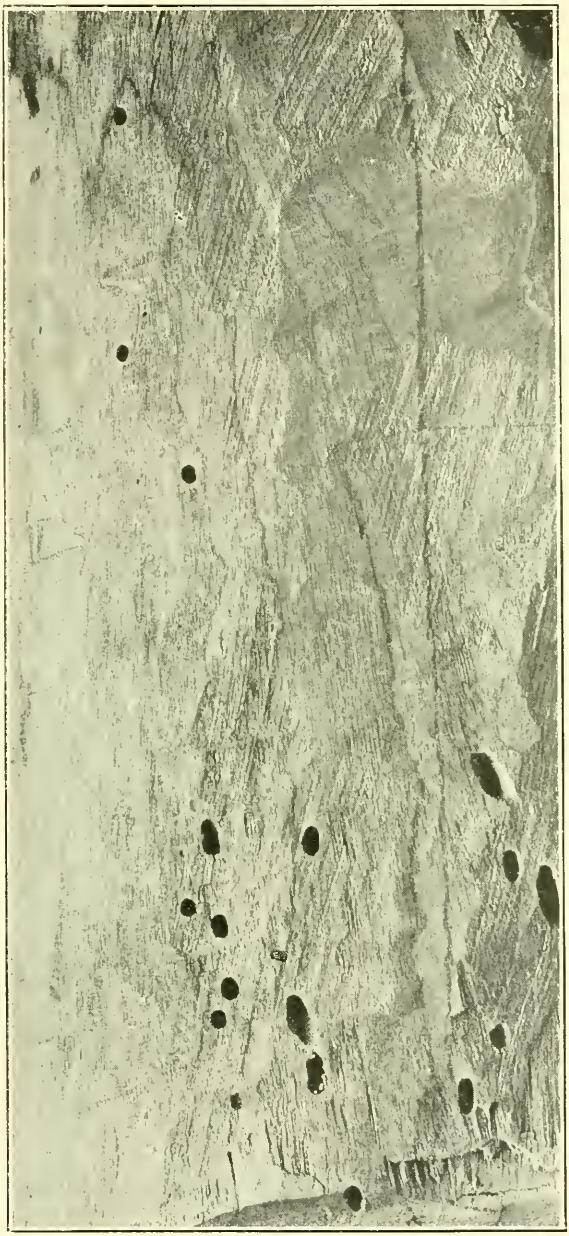
FOR EXPLANATION OF PLATE SEE PAGE 208.





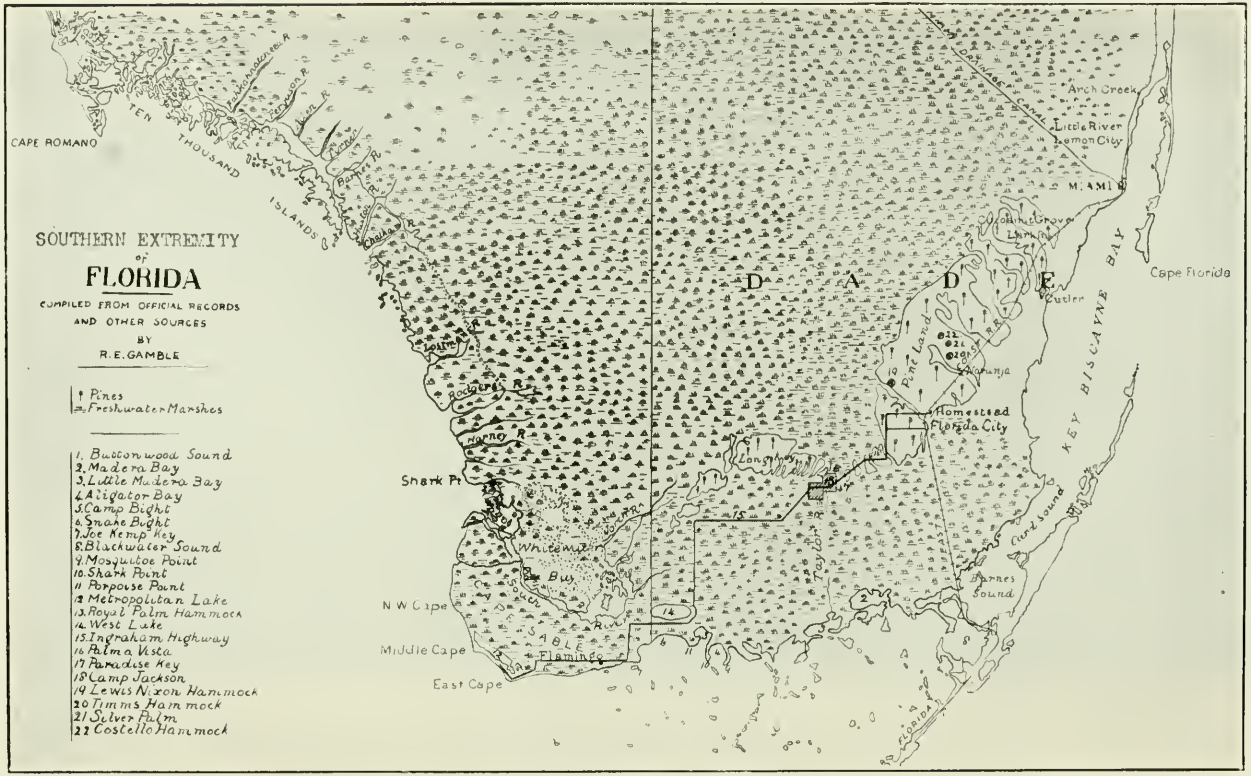
1. Reticulitermes hesperus Worker with Fungous Disease.
2. Termopsis angusticollis Burrows in Western Yellow Pine.

For explanation of plate see page 208.



Entrance Holes of Kalotermes in Dry Hard Wood of Dead Tree. Arizona.

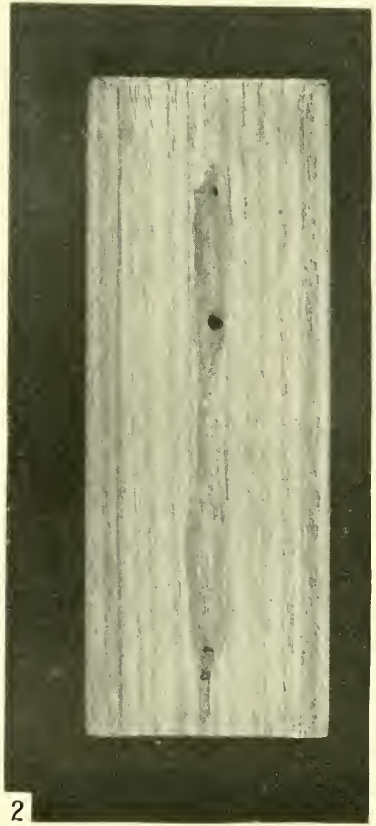
For explanation of plate see page 208.


SOUTHERN EXTREMITY
of
FLORIDA
COMPILED FROM OFFICIAL RECORDS
AND OTHER SOURCES
BY
R. E. GAMBLE
Pines
Freshwater Marshes
1. Buttonwood Sound
2. Madera Bay
3. Little Madera Bay
4. Aligator Bay
5. Camp Bight
6. Snake Bight
7. Joe Kemp Key
8. Blackwater Sound
9. Mosquitoe Point
10. Shark Point
11 Porpoise Point
12 Metropolitan Lake
13. Royal Palm Hammock
14. West Lake
15. Ingraham Highway
16 Palma Vista
17 Paradise Key
18 Camp Jackson
19 Lewis Nixon Hammock
20 Timms Hammock
21 Silver Palm
22 Costello Hammock
CAPE ROMANO
TEN THOUSAND ISLANDS
Barnes R.
Chatham R.
Lostmans R.
Rodgers R.
Harney R.
Shark Pt
N W Cape
Middle Cape
East Cape
Whitewater Bay
CAPE SABLE
Flamingo
D A D E
DRAINAGE CANAL
Arch Creek
Little River
Lemon City
MIAMI
Coconut Grove
Larkin
Cutler
Cape Florida
BISCAYNE BAY
KEY BISCAYNE
Pine Land
Naranja
Homestead
Florida City
Long Key
Taylor R.
Card Sound
Barnes Sound
FLORIDA

Map of Extremity of Southern Florida, Showing the Lower Everglades--A Region in Which Termites are Common.

For explanation of plate see page 209.

1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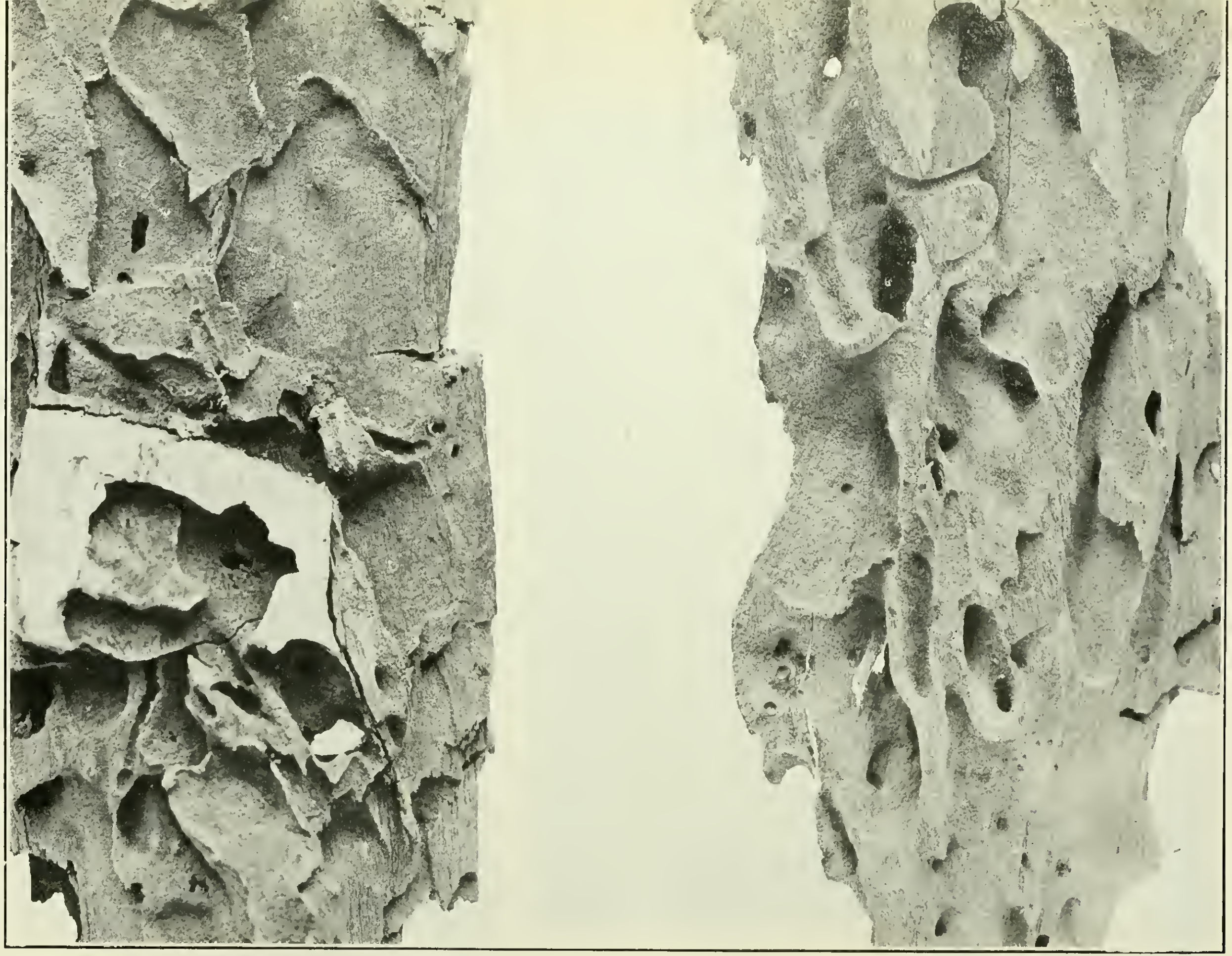
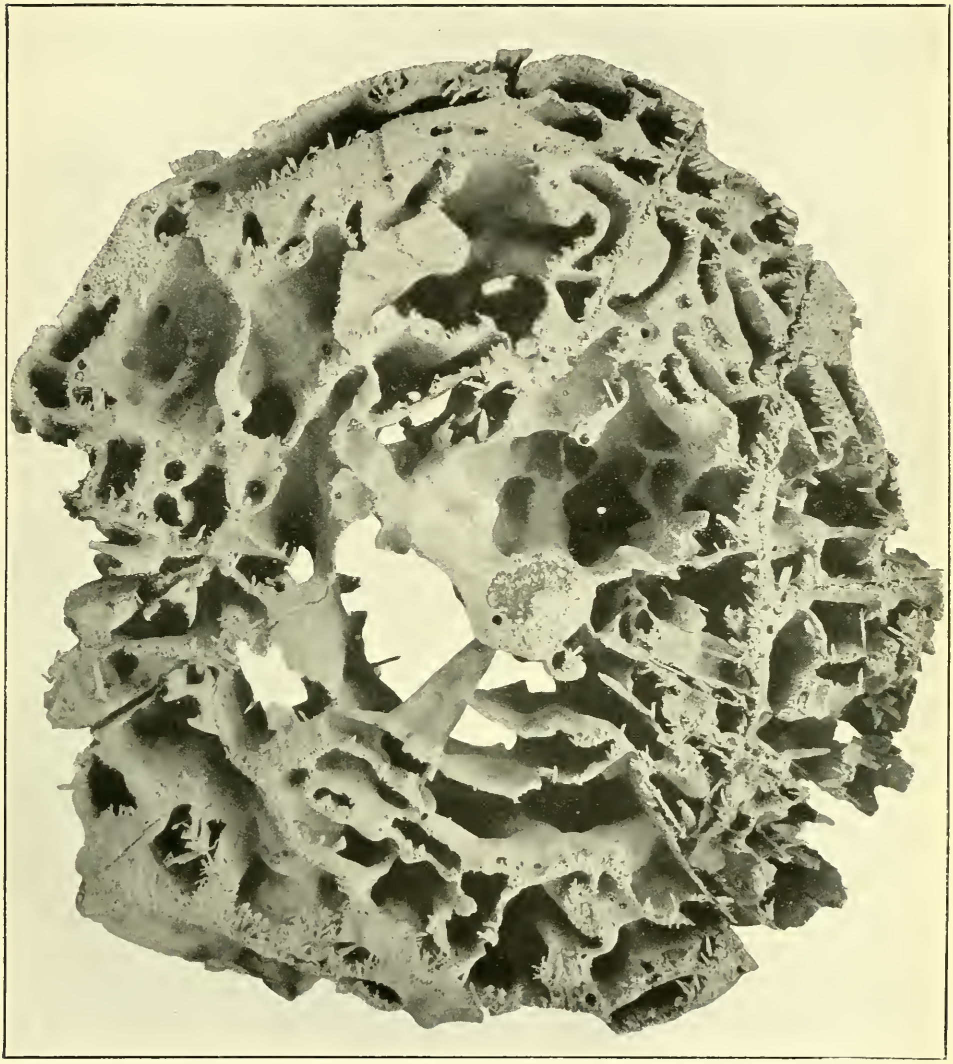
1 AND 3. DAMAGE BY KALOTERMITIDAE. 2. DUDLEY AND BEAUMONT'S "NE PLUS ULTRA" CALOTERMITARIUM.

FOR EXPLANATION OF PLATE SEE PAGE

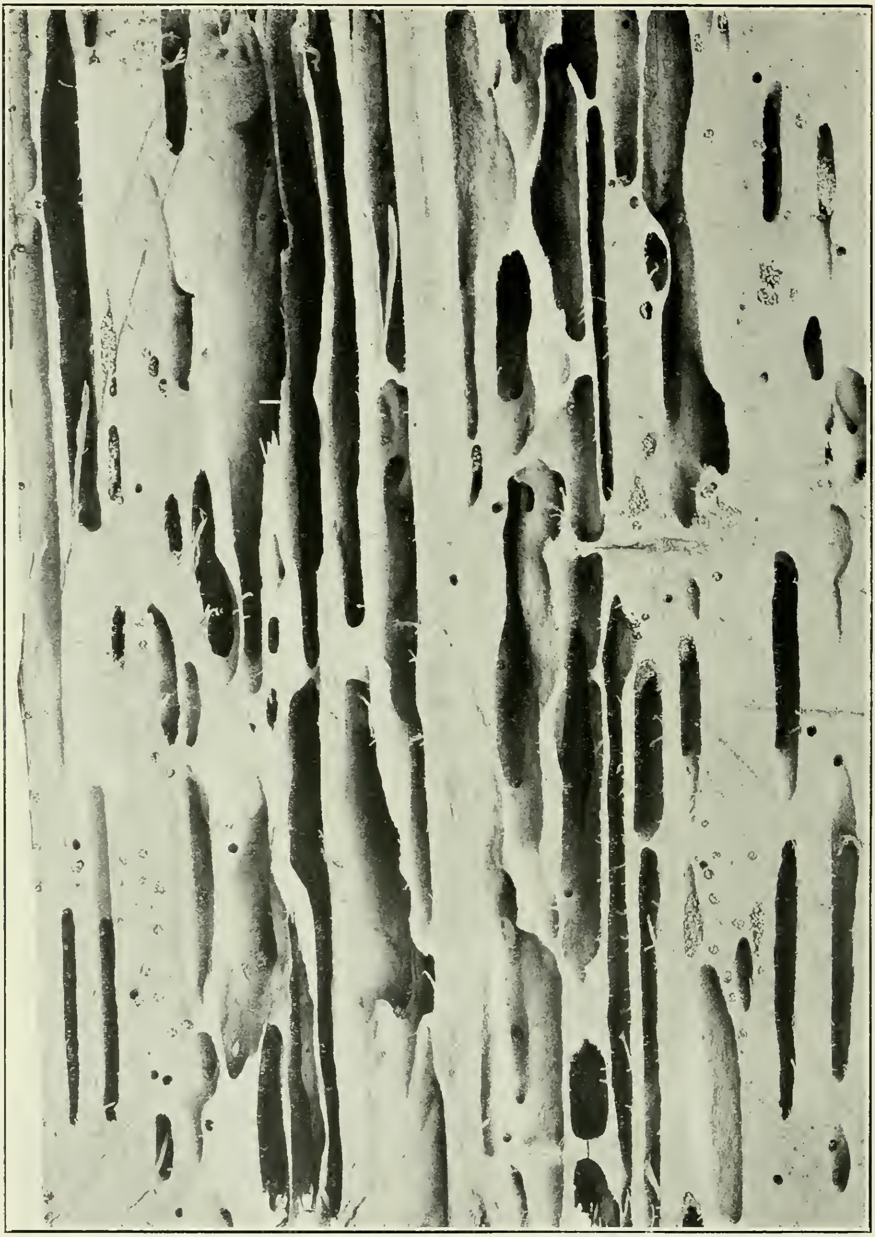


DRY HARD WOOD OF DEAD COTTONWOOD TREE RIDDLED BY KALOTERMES IN ARIZONA.



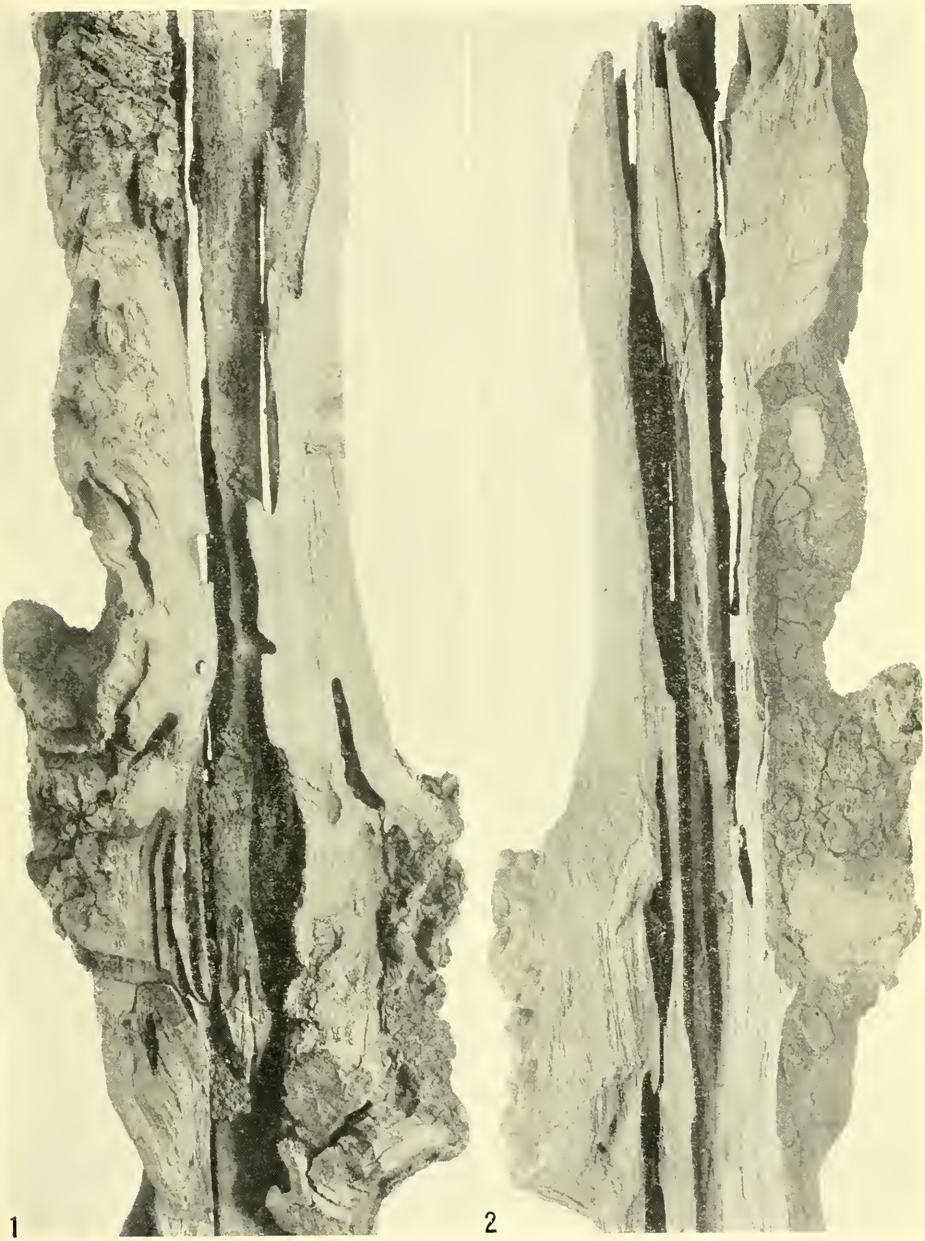
DAMAGE BY KALOTERMES HUBBARDI TO RAFTERS IN "ADOBE" BUILDING IN ARIZONA.

FOR EXPLANATION OF PLATE SEE PAGE 209



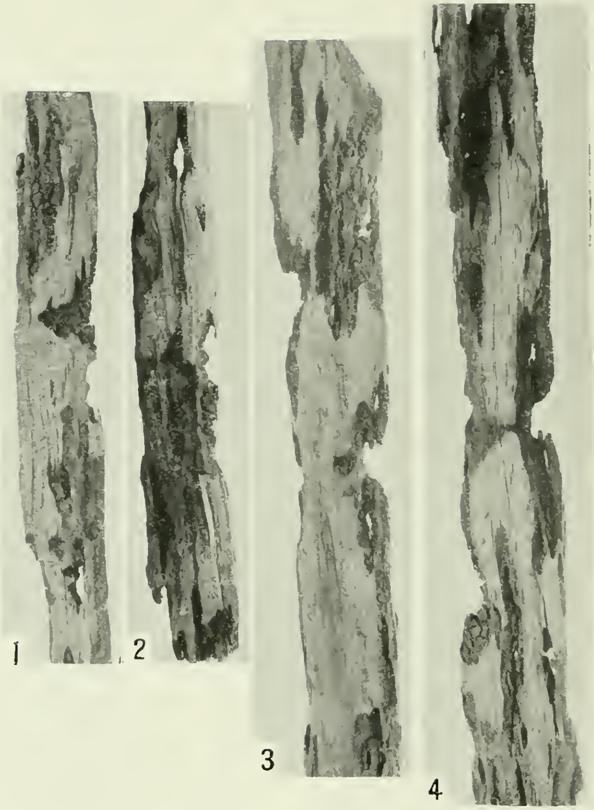
DAMAGE BY KALOTERMES HUBBARDI TO RAFTERS IN "ADOBE" BUILDING IN ARIZONA.

FOR EXPLANATION OF PLATE SEE PAGE 209.



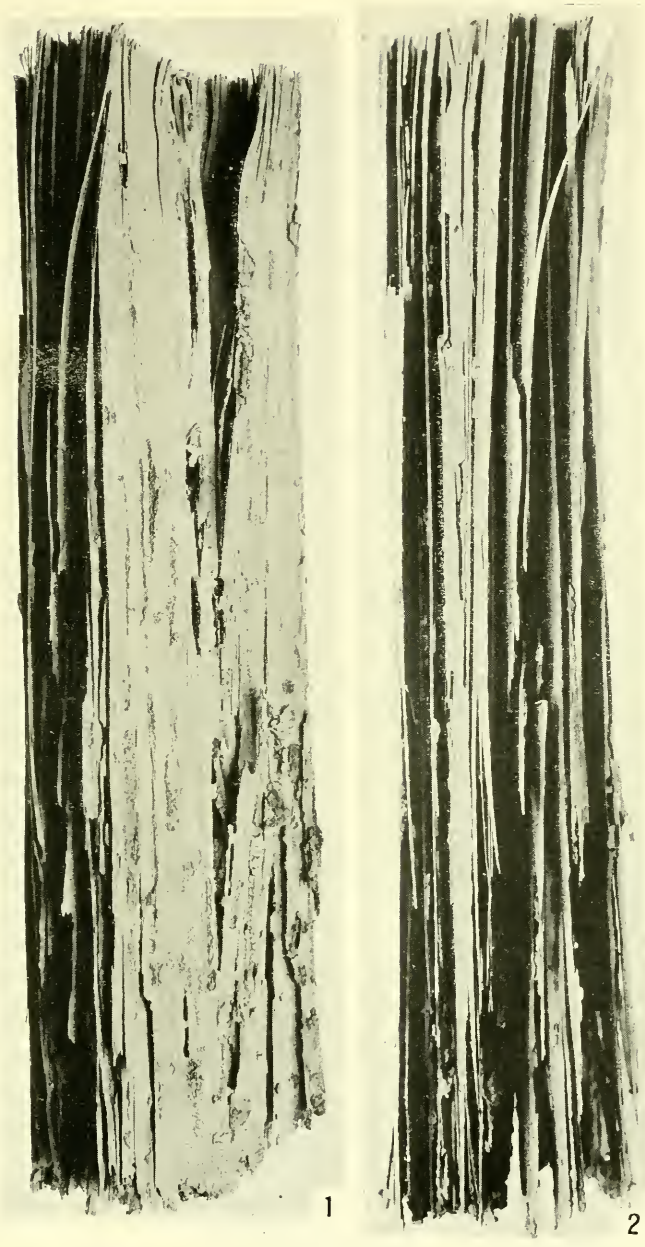
Work of Neotermes castaneus in Solid Wood of Red Mangrove Log.

For explanation of plate see page 209.



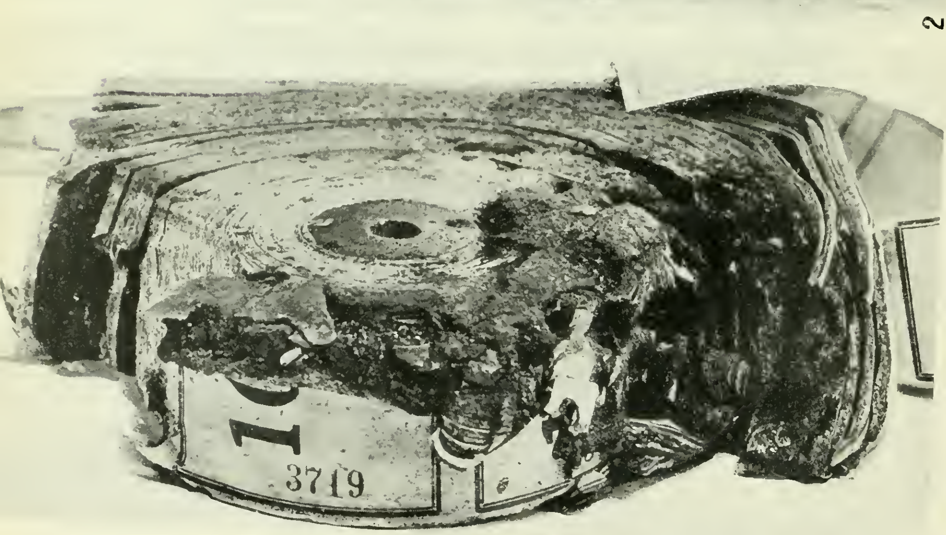
Wood of Red Mangrove Log Honeycombed by Prorhinotermes simplex. Florida.

For explanation of plate see page 209.



Timber of Building Reduced to Consistency of Paper by Reticulitermes in New Orleans, Louisiana.

For explanation of plate see page 209.



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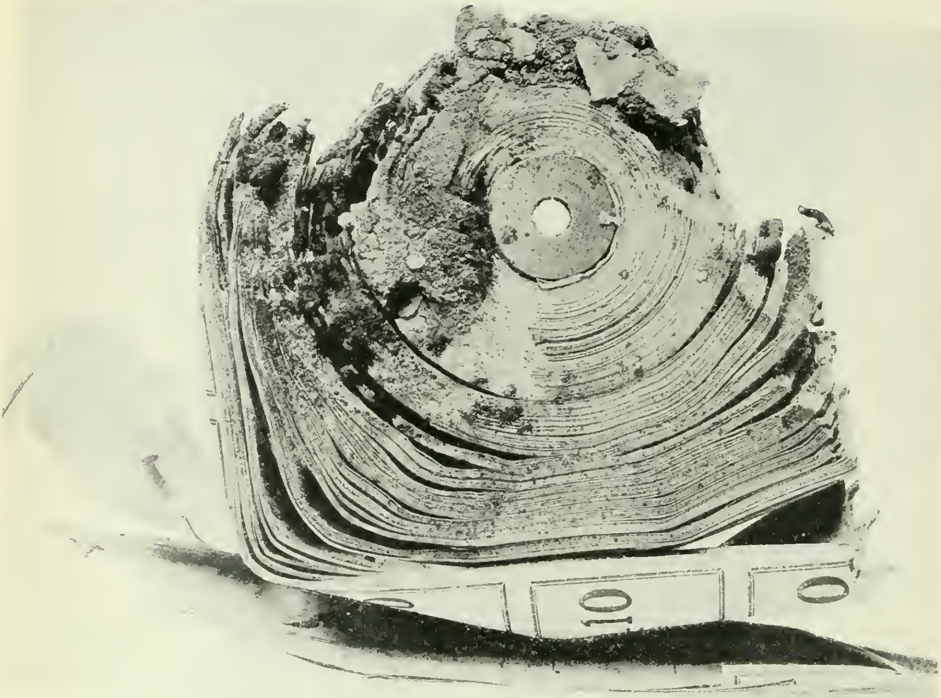

2

Damage by Reticulitermes flavipes to Roll of Paper Labels in Infested Building. Bloomfield, New Jersey.

For explanation of plate see page 209

1

2

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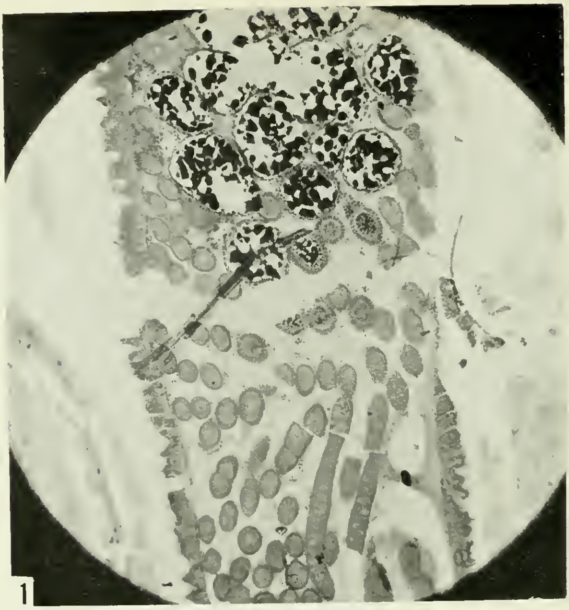
4

PHOTOGRAPHS OF LONGITUDINAL MICROTOME SECTIONS OF THE ABDOMENS OF THREE DIFFERENT TYPES OF EGG-LAYING QUEENS.

FOR EXPLANATION OF PLATE SEE PAGES 209 AND 210.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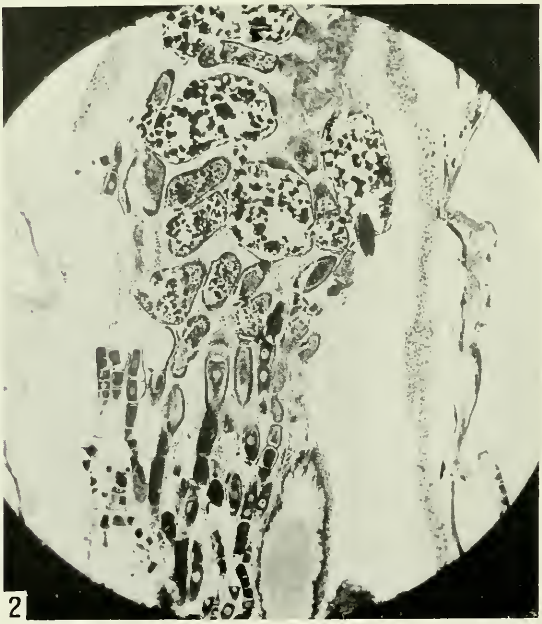
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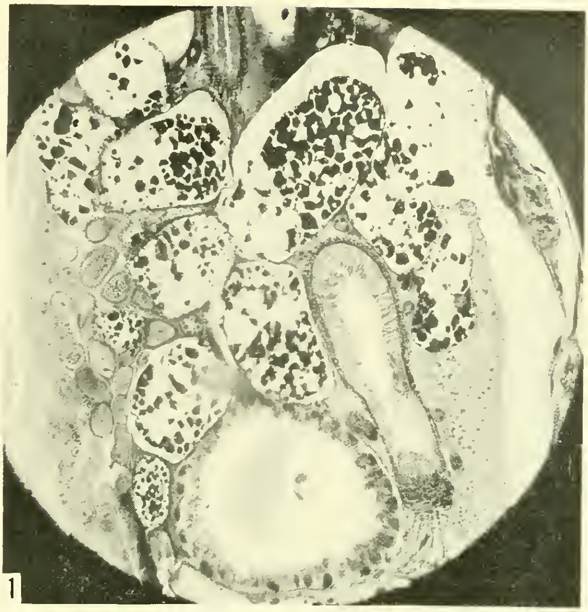
LONGITUDINAL SECTIONS OF THE ABDOMENS OF EGG-LAYING QUEENS.

FOR EXPLANATION OF PLATE SEE PAGE 210.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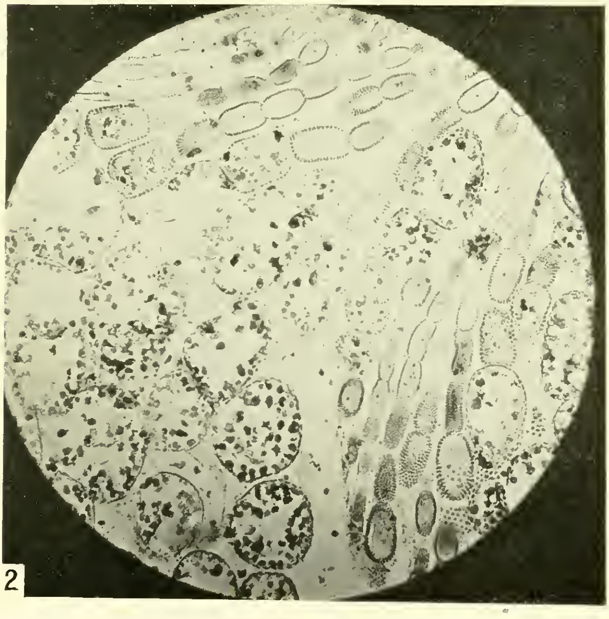
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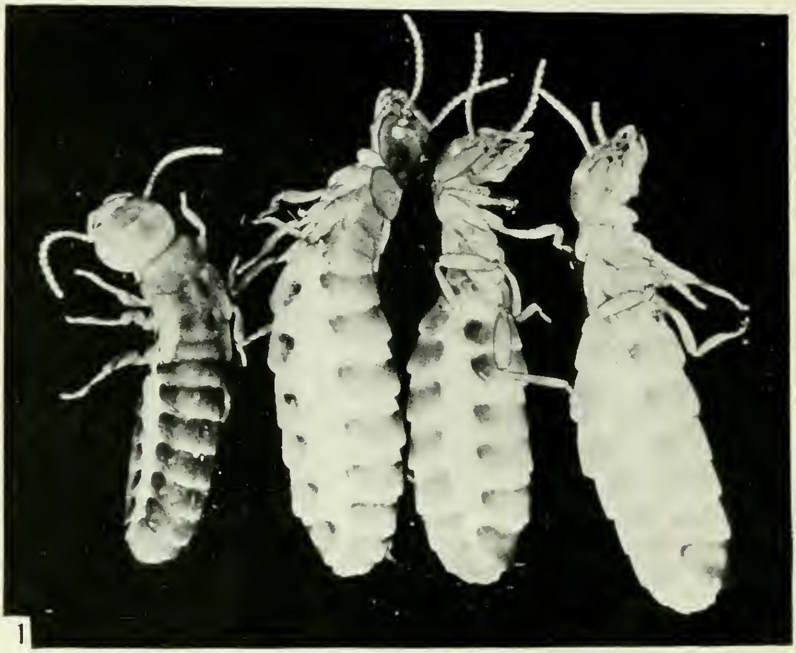
LONGITUDINAL SECTIONS OF THE ABDOMENS OF EGG-LAYING QUEENS.

FOR EXPLANATION OF PLATE SEE PAGE 210.



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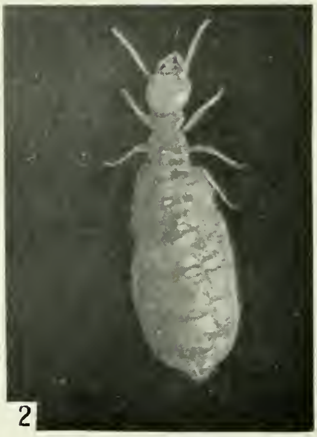
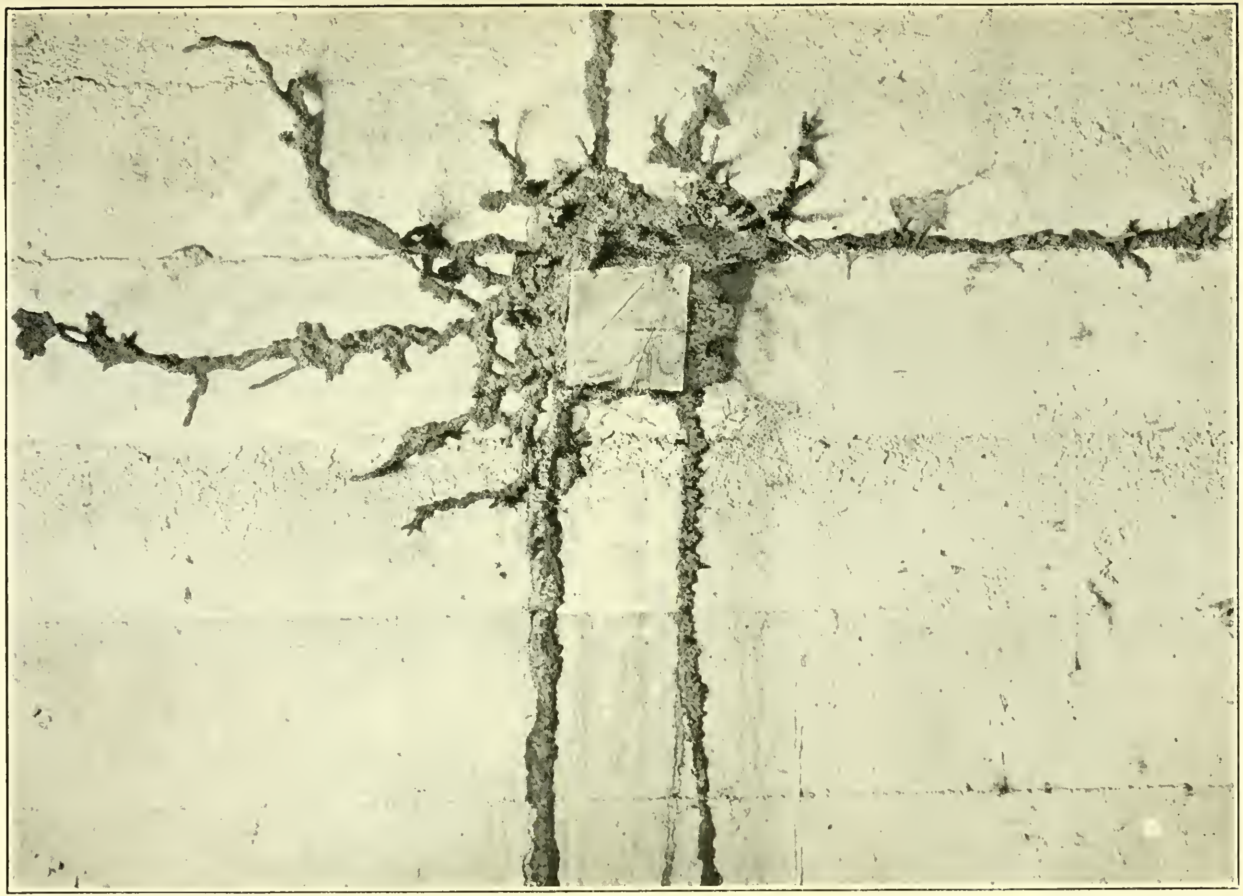


2

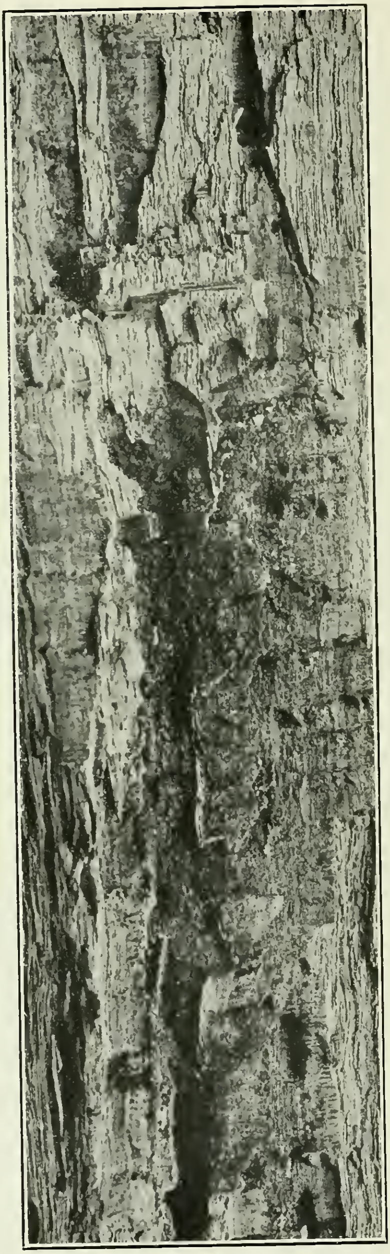
SECOND AND THIRD FORM REPRODUCTIVE INDIVIDUALS OF RETICULITERMES.

FOR EXPLANATION OF PLATE SEE PAGE 210.



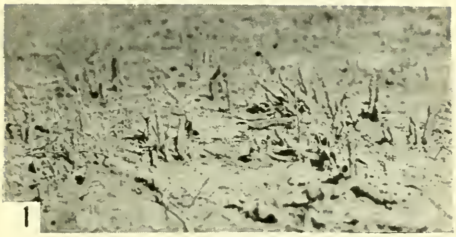
Tubes Constructed by Reticulitermes hesperus on Wall of Infested Building. Los Angeles, California.

For explanation of plate see page 210.

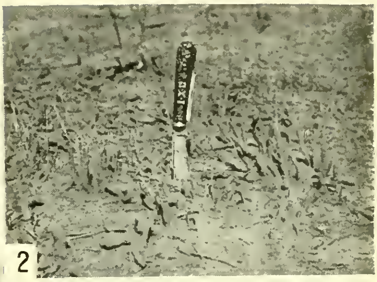


DAMAGE TO SOLID OAK WOOD BY RETICULITERMES HUMILIS, VAR. HOFERI IN ARIZONA.

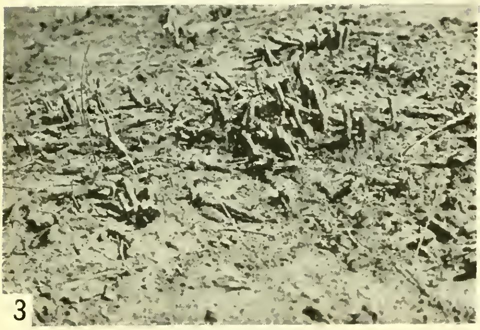
FOR EXPLANATION OF PLATE SEE PAGE 210.



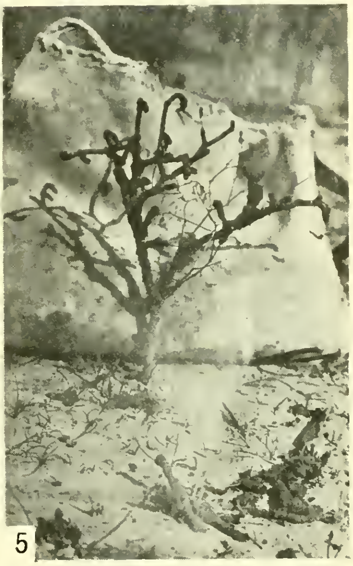
1



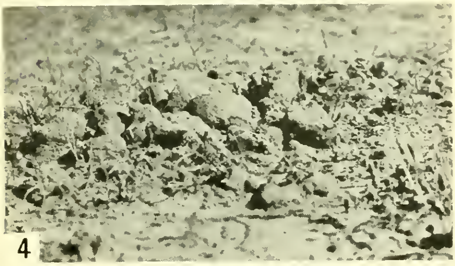
2



3



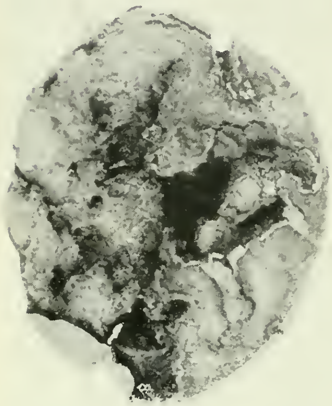
5

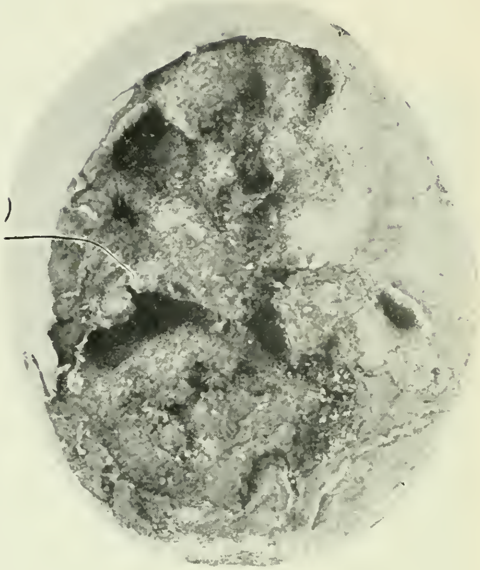


4

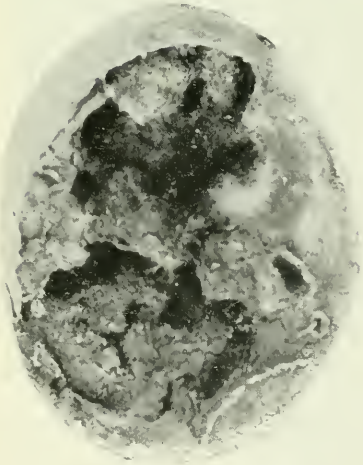
Tubes Constructed by Amitermes tubiformans Over Living Vegetation in Prairie Pastures in Southwestern Texas.

For explanation of plate see page 211.

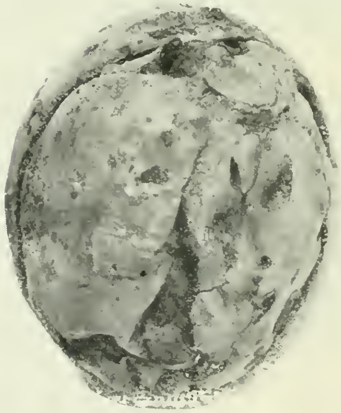




2



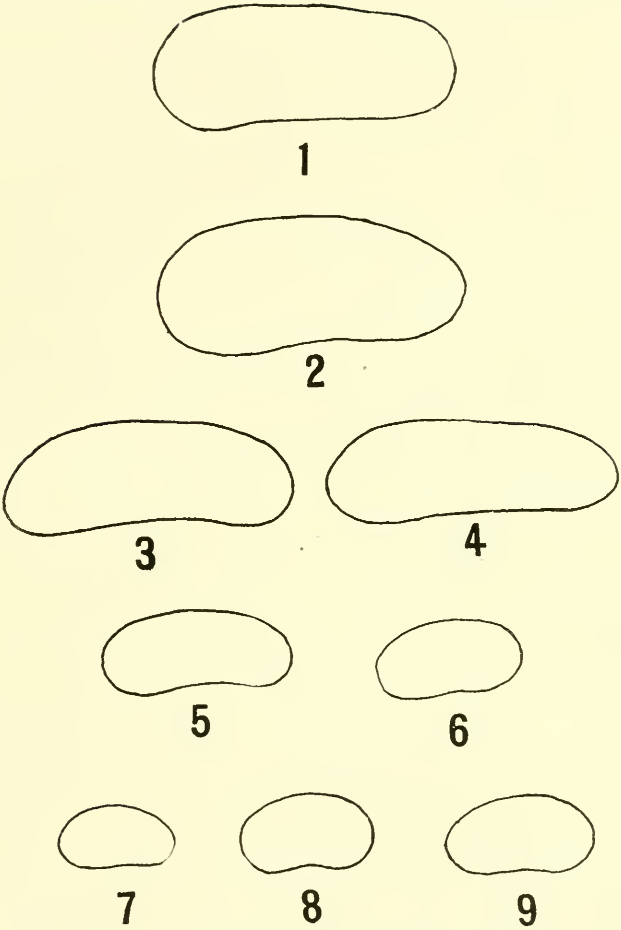
1



3

Damage to Potatoes by Reticulitermes.

For explanation of plate see page 211.



EGGS OF NINE GENERA OF NEARCTIC TERMITES.

FOR EXPLANATION OF PLATE SEE PAGE 211.

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